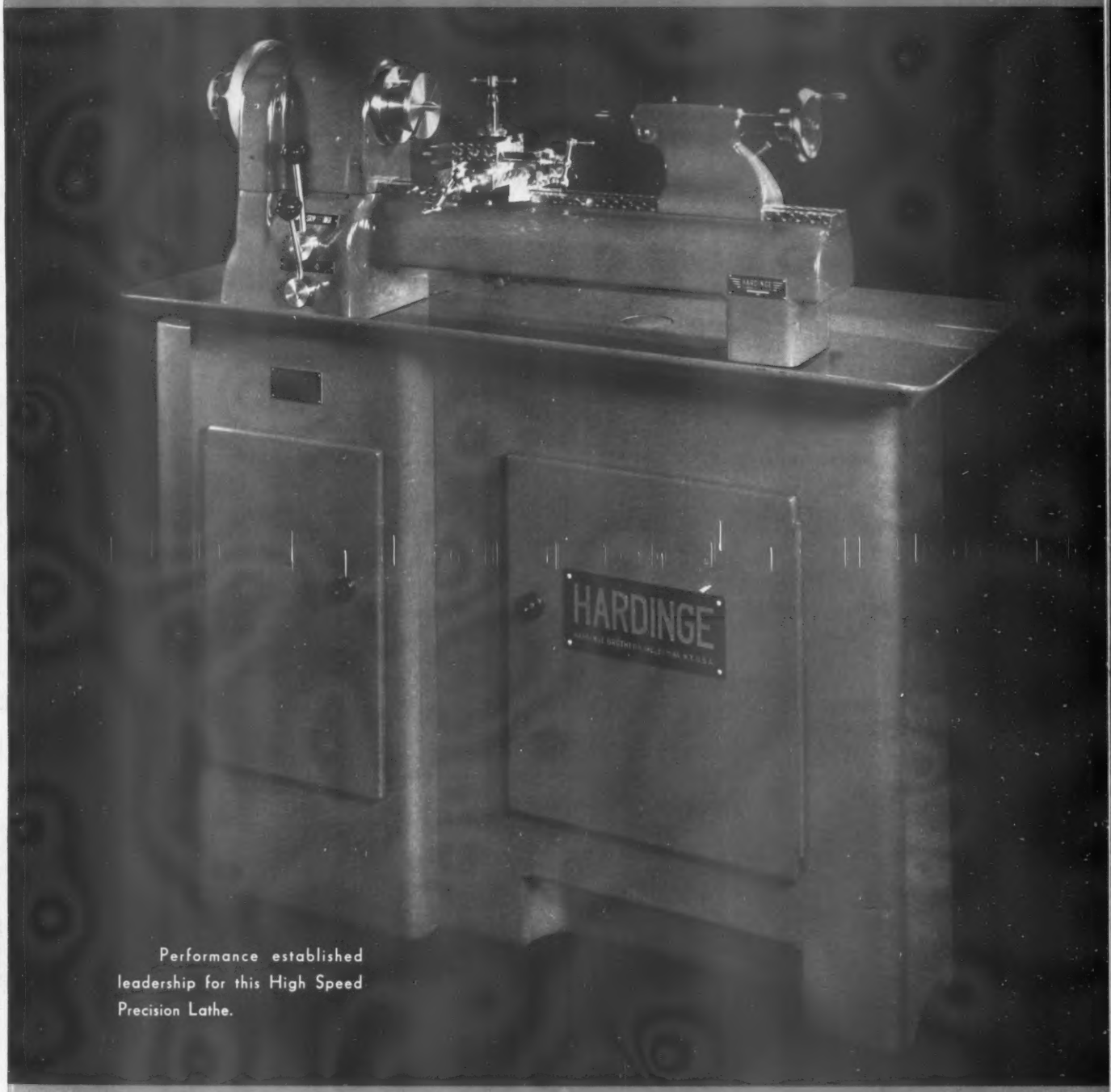
DECEMBER, 1940

The TOOL ENGINEER

MACHINERY • PRODUCTION • TOOLS

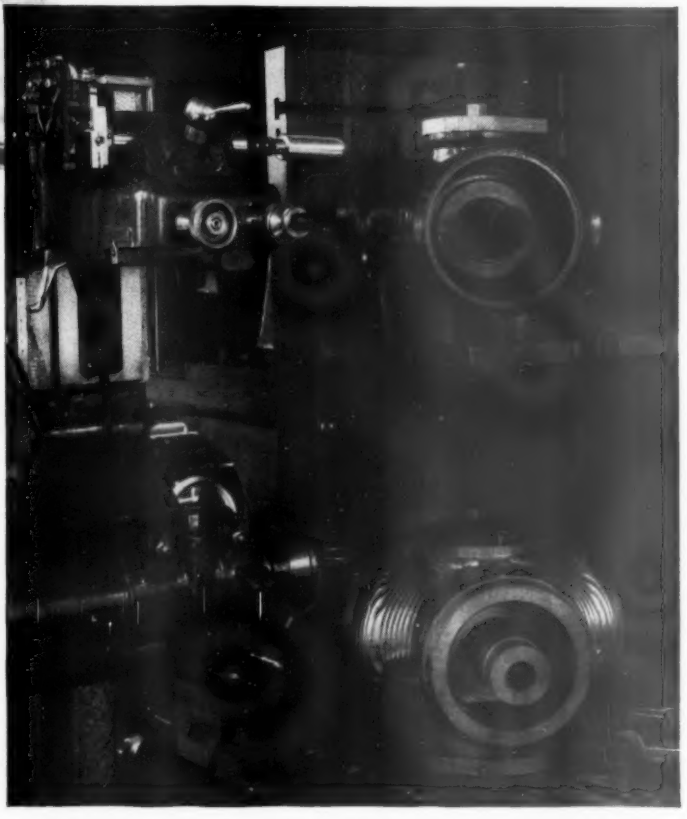


Performance established leadership for this High Speed Precision Lathe.

Official Publication AMERICAN SOCIETY OF TOOL ENGINEERS

EXPERIMENTING?

Make the Real Thing ···Model into Metal··· Quickly, at Low Cost!



Keller makes a roughing cut on three-blade experimental propeller hub. *Only one-third* of wooden master was finished to size—metal hub was produced by indexing at 120° intervals. Later this became part of a finished experimental propeller which was flight tested.

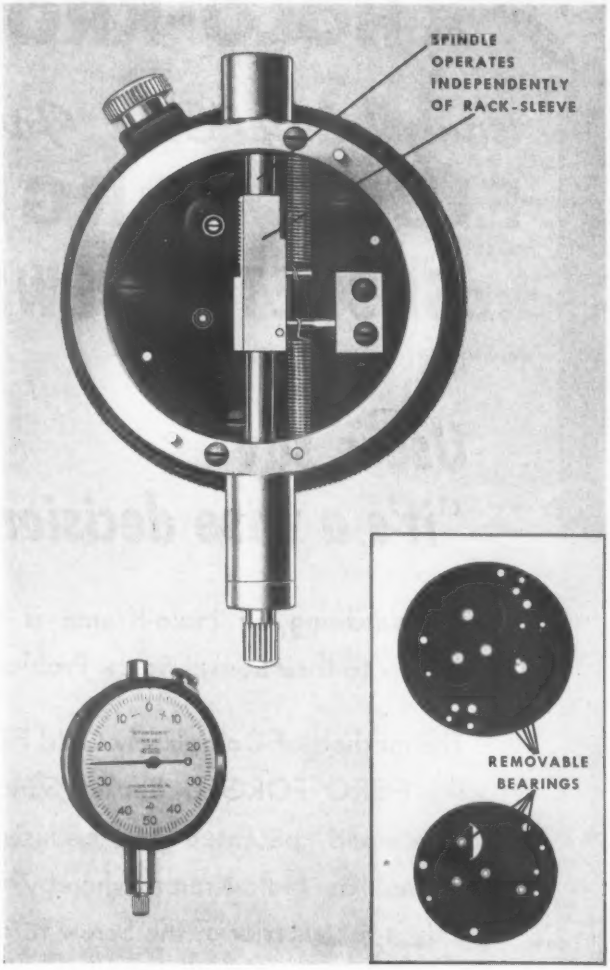
WITH new products the order of the day . . . with national defense making unusual demands upon the facilities of industry . . . manufacturers are discovering an immense *additional* advantage in their Keller Machines. In many a case where the Keller was purchased primarily for die-cutting, it is now in valuable *additional* service as a producer of *experimental parts.* Take *both* these services into consideration when you calculate the return on your investment—past or future—in a Keller.

Fully automatic, the Keller cuts complex three-dimensional work with amazing accuracy in any material, large jobs or small. Making experimental parts, Keller serves this way: actual-size model is made in wood, cement, or the like. This master is mounted on the Keller, and perhaps a dozen exact duplicates are cut in whatever metal the finished part is to be. These identical experimental units are then used as needed—for breakdown tests, analyses for metallurgical properties, samples for contract bid jobs, etc. This method removes any question of design quality, and all kinks are ironed out *before* investment in tools and fixtures is made. And many times this experimental method, with a little more permanent fixturing, becomes the best production method for the job.

Keller does regular die work quicker, better, cheaper . . . produces experimental parts at low cost, fast, *in the actual metal.* Write for details, or ask any P&W representative.

PRATT & WHITNEY
Division **Niles-Bement-Pond Company**
West Hartford, Connecticut, U. S. A.

KELLER MACHINES



shock-proof!

SUSTAINED higher accuracy and longer life are provided by "Standard" dial indicators equipped with shock-proof mechanism—kept dust- and moisture-proof within the indicator body itself.

● All shock against contact point is absorbed by a rack-sleeve sliding action on spindle . . . none transmitted to measurement mechanism. And no jar from spindle return movement! INDICATOR REPEATS EXACTLY.

This construction also permits reduced gear weight, less surface contact between moving parts, and uniform gear action regardless of the checking speed. Less inertia . . . lower friction . . . greater sensitivity . . . decreased wear.

Individual replaceable bearings for spindle (hardened steel, ground and lapped) and for the special involute-toothed pinions and gears, further cut maintenance cost.

Address: Standard Gage Company, Inc., 80 Parker Ave., Poughkeepsie, N. Y.

STANDARD *Gages*

1479

Standardize ON HOLO-KROME

Completely Cold Forged
FIBRO FORGED
TRADE MARK
SOCKET SCREWS

Users say "it's a wise decision"

Standardizing on Holo-Krome is the answer to their Socket Screw Problems.

The method of Completely Cold Forging FIBRO FORGED Socket Screws, developed, patented and exclusively utilized by Holo-Krome whereby not only is the exterior of the Screw forged but the actual Socket, the Side Walls, the Head, in fact, every particle of the Screw (threads excepted) is Completely Cold Forged, results in

Guaranteed
UNFAILING PERFORMANCE

HK HOLO-KROME

fibro forged TRADE MARK

THE HOLO-KROME SCREW CORP. **SOCKET SCREWS** HARTFORD, CONN. U.S.A.

THE TOOL ENGINEER

"America in the Making"

CONTENTS OF VOLUME IX NUMBER 8

December, 1940

ROY T. BRAMSON
Editor and Publisher

J. A. ASHBURN
Associate Editor

R. E. GILLESPIE
Business Manager

B. C. YOHE
Circulation Manager

Published by
THE BRAMSON PUBLISHING CO.
2842 W. Grand Boulevard
DETROIT, MICHIGAN
MAdison 7553

ADVERTISING OFFICES

New York City
A. M. Willcox
420 Lexington Avenue
Lexington 2-4816

Chicago, Illinois
Dwight H. Early
100 N. LaSalle Street
CENtral 4158

Providence, R. I.
Herman T. Pierik
4 Weybosset Street
GAspee 1568

Detroit, Michigan
Thomas J. Orlando
2842 W. Grand Blvd.
MAdison 7553

San Francisco, Calif.
R. H. Walker
Mills Building

Los Angeles, Calif.
Wentworth Green
Western Pacific Bldg.

A. H. d'Arcambal, *President*

AMERICAN SOCIETY OF TOOL ENGINEERS

2567 W. GRAND BLVD., DETROIT, MICH.

Ford R. Lamb, *Executive-Secretary*

E. W. Dickett, *1st Vice-President* — **F. R. Crone, *Treasurer***
E. A. Rutzen, *2nd Vice-President* — **C. O. Hersam, *Secretary***

Application blanks and information pertaining to membership in the American Society of Tool Engineers may be had by addressing The Tool Engineer, 2842 W. Grand Blvd., Detroit, Mich., or the Secretary's office, 2567 W. Grand Blvd., Detroit, Mich. Dues are $5 initiation fee, $6 per year for senior grade membership and $3 per year for junior grade membership. Junior membership initiation fee $2.

WANT TO LOWER YOUR MILLING COSTS?

THE DATA

	OPERATION NO. 1	OPERATION NO. 2
Name of Part	Front Axle.	
Material	2" x 3" HRS, 180-190 Brinell hardness.	
Operation	Straddle Mill the ends of two front axles at a time.	Form Mill the ends of two axles at a time.
Machine	Gooley & Edlund Mill.	No. 3 Cincinnati Mill.
Cutters	Four 8½" x 1" x 2" Barber-Colman "Paraform" Side Milling Cutters.	Two 1¼" radius Barber-Colman Formed Cutters.
Holding	Screw clamps.	Screw clamps.
Stock Removed	Straddle Cut, 2.750"-2.740" x 2", removes 1 cu. inch stock from two sides of each end.	Forming Cut, 2" x 3" x 1¼" radius, removes 0.9" cu. inch from each end.
Feed	1.00" per min.; 0.045" per rev.; chip load, 0.042" a min. per tooth.	0.30" per min.; 0.0125" per rev.; chip load, 0.063" a min. per tooth.
Speed	22 r.p.m.; 48 surface feet.	41 r.p.m.; 65 surface feet.
Production Time	2 minutes cutting and 1 minute loading per end.	14 minutes cutting and 1 minute loading per end.
	(Total time per piece 18.86 minutes. One man operates both millers and a drill press, and governing time is on Operation No. 2)	
Pieces per Grind	500 (Milled on both ends).	200 (Milled on both ends).

USE BARBER-COLMAN "PARAFORM" CUTTERS Like This Tractor Builder

Massey-Harris Co., Racine, Wisconsin, take full advantage of these savings in building fine tractors.

Operation No. 1 employs four "Paraform" Side Mills, which machine top and bottom of two front axles at one time in 3 minutes floor-to-floor. Cutter performance is 1000 cuts per grind. In Operation No. 2, two Formed Milling Cutters round the ends of two axles in 15 minutes floor-to-floor, producing 400 ends, per grind. One man runs both mills besides a drill press.

The unique design of "Paraform" Cutters, plus their rigidly guarded high quality, and precision sharpening on Barber-Colman sharpening machines, accounts for this record performance.

Do you want to know if B-C Standard "Paraform" Cutters will reduce your milling costs? Order a set for one of your jobs today, and try them out yourself. Standard "Paraform" Cutters are stocked for immediate delivery.

BARBER B-C COLMAN

PRODUCTS

HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

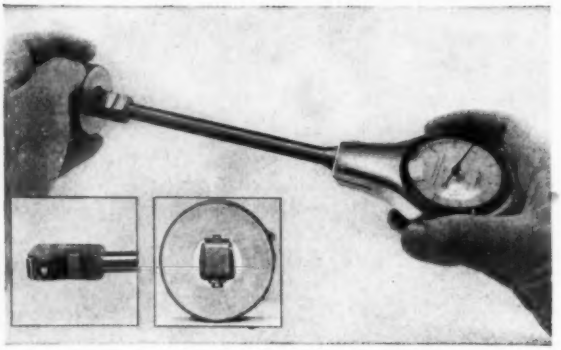
Consult your Catalog K for information on B-C Cutters, Hobs, and Reamers. If you are having cutter difficulties, consult your Barber-Colman Cutter Engineering Service. There is no charge or obligation for recommendations.

Barber-Colman Company

General Offices and Plant 213 Loomis St., Rockford, Illinois, U. S. A.

PRECISION for DEFENSE

REQUIRES MODERN TYPE GAGES FOR CHECKING HOLES

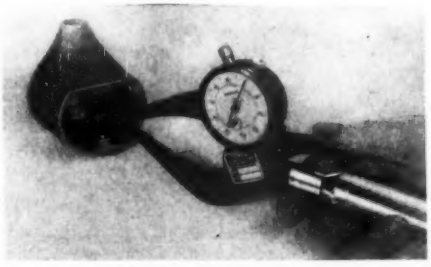


Model 1201 P, a very sensitive and light hand Dial Gage for checking small holes.

Model 165, a trigger operated Dial Gage. Plugs are interchangeable.

Sensitive plug gages with Dial Indicators eliminate human variations. They are faster, show the facts as they are, *without* that uncertain blind spot common to "go and no-go" gages, and tell more about tapered, out-of-round, and bellmouthed holes.

Work which would otherwise be scrapped can be sorted and saved to use with other parts. Federal Dial Indicator Gages are being used more and more in place of solid plug gages. Use them to speed up defense work.



Model 149, an inside Caliper Type of Dial Gage. Very handy and practical.

Model 36 B-6, a bench type of Small Hole Dial Gage. Adjustable for pressure.

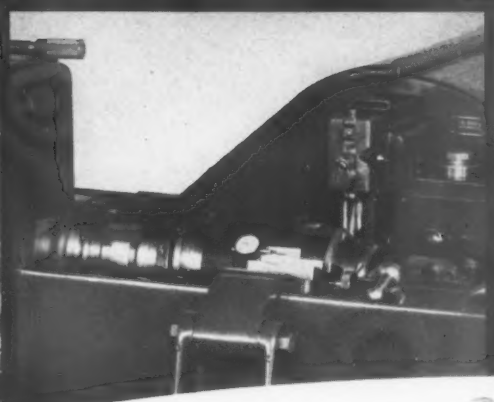
It's Quicker to Use a Dial Indicator

FEDERAL PRODUCTS CORP., 1144 EDDY ST., PROVIDENCE, R. I.

FEDERAL

PRECISION MEASURING INSTRUMENTS

Chicago • *Cleveland* • *Detroit* • *Hartford* • *Muncie*
New York • *Philadelphia* • *Pittsburgh* • *Rochester*

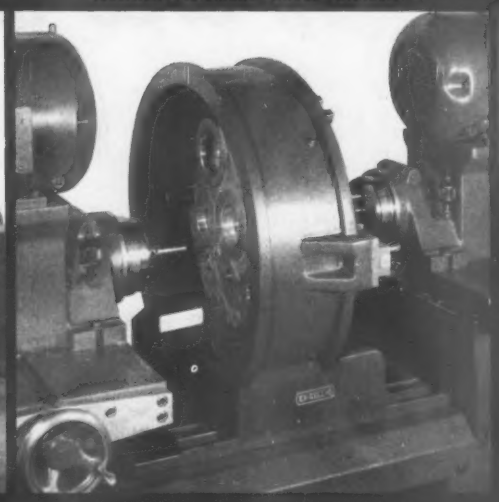


Precision . . . COMES INTO ITS OWN!

IN a practical way, an Ex-Cell-O Precision Machine represents a basic requirement of modern industry—*extreme accuracy in measurement.* Without exceedingly fine measurements—as available with every Ex-Cell-O machine—and the interchangeability of parts that such precision allows, today's mass production of manufactured products would be impossible . . . the vital high production speed on which the success of our nation's defense program now depends could not possibly be attained. Ex-Cell-O is a pioneer in constantly developing higher standards of precision performance with machine tools. This is why today—in quantity production of vital parts for airplanes, automobiles, tractors, and almost every other major product requiring metal parts held to closest possible limits—Ex-Cell-O Precision Machines and Tools are being widely used in all the important industries. If your problem is one that involves the making of precision metal parts on a high-speed, economical basis, you will find it well worth-while to consult Ex-Cell-O.

EX-CELL-O CORPORATION · 1204 OAKMAN BLVD. · DETROIT, MICH.

Style 1212 Precision Boring Machine finish boring holes in aluminum piston assembly for hydromatic propellers.



Ex-Cell-O Machine rough and finish boring, chamfering and facing magnesium alloy rear case for aircraft engine.

A 12 pitch thread being ground from the solid on rotating propeller cam on 31 Ex-Cell-O Precision Thread Grinder.

...nplane studs being ground from the solid on battery of Ex-Cell-O Style 33 Precision Automatic Thread Grinders.

Turning and chamfering aluminum piston for liquid cooled aircraft engine on an Ex-Cell-O Precision Boring Machine.

EX-CELL-O (XLO) *Precision* **MACHINES AND TOOLS**

EX-CELL-O CORPORATION
1204 Oakman Blvd., Detroit, Michigan

Please send bulletins on Thread Grinding and Precision Boring.

Name _____ *Title* _____

Company _____

Address _____

Called in the Draft—

...THIS GISHOLT TURRET LATHE!

THESE are times when the good of all calls for sacrifices from a few. And it concerns not only men, but also the machines which are so urgently needed to produce the essentials of our national defense.

We, like other machine tool builders, have been obliged to divert machines in certain cases. We don't like to disappoint any good friend and customer. But when America's defense takes first call, Gisholt machines are sometimes "drafted" into service where they are most vitally needed.

We commend the loyal attitude of those who sacrifice their own plans that the national program might proceed more swiftly. And we are doing everything within our power—working night and day—straining every resource—to build as many Gisholts as possible, as quickly as possible.

GISHOLT MACHINE COMPANY
1229 East Washington Avenue
Madison • Wisconsin

Look ahead—keep ahead—with Gisholt improvements in metal turning

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

USE "LOGAN" EXPERIENCE ON YOUR SHELL HOLDING EQUIPMENT ★ ★ ★ ★

★

FOR over twenty years "LOGAN" has made air and hydraulic operated holding devices for all sizes and types of shells or similar forgings—but to the best of our knowledge this is the first time drawings and data of this type have been assembled and made available for general use. "LOGAN" Collet Chucks and "LOGAN" Expanding Mandrels illustrated in this new bulletin have been tested in actual daily service with excellent results. You can't afford to turn down the advantages of "LOGAN'S" experience on Shell Holding Equipment. Write today for the new "LOGAN" Air and Hydraulic Operated Shell Holding Bulletin.

★

WRITE FOR 20-PAGE SHELL HOLDING BULLETIN

LOGANSPORT MACHINE, INCORPORATED

902 PAYSON ROAD, LOGANSPORT, INDIANA

Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

THE *Precision* REQUIRED FOR MODERN INDUSTRY

SOUTH BEND LATHES

South Bend Lathes are designed and built to provide the extreme precision required in modern industry. They are giving tool room accuracy on close-tolerance production work in hundreds of manufacturing plants throughout the United States. The smooth, vibration-free belt drive to the spindle permits finish turning or boring with such precision that subsequent grinding, honing or lapping operations can often be eliminated.

South Bend Lathes are made in 9″, 10″, 13″, 14½″ and 16″ swing, in 3′ to 12′ bed lengths, in Motor Drive and Countershaft Drive.

SOUTH BEND LATHE WORKS

LATHE BUILDERS SINCE 1906

927 E. Madison St., South Bend, Ind., U.S.A.

FOR CRITICAL MACHINE PARTS UTILIZE . . . .

AIRKOOL

FOR EXTREME WEAR RESISTANCE AND TOUGHNESS

ATTENTION !

- ✔ *Production Men*
- ✔ *Master Mechanics*
- ✔ *Engineers*

AIRKOOL CAM

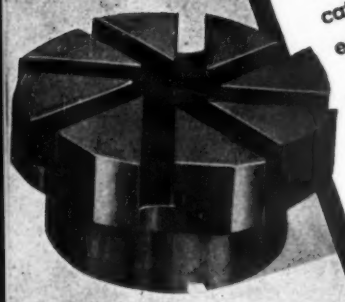
$5\frac{3}{32}$" diameter, 1¼" thick, weight 6 lbs. The service requirements are extreme resistance to wear and toughness. Too, this part with thick and thin sections was difficult to harden. Complications with previously used Alloy Steels were solved with AIRKOOL.

PRODUCTION MEN, MASTER MECHANICS and ENGINEERS are today concerned with maintaining machines straining under unequalled production demands. On critical parts requiring too frequent replacements, many are turning to some of the newer tool and die steels on applications formerly served by alloy steels. Many such interesting examples concern Crucible's AIRKOOL.

Thousands of Tool and Die Makers know AIRKOOL as the unusually tough steel that's readily machinable with minimum distortion and unusual wearing properties. Outstanding too, is its simple air hardening treatment. Now these same properties are being profitably applied by PRODUCTION MEN, MASTER MECHANICS and ENGINEERS for important machine parts.

Pictured here are two such examples where AIRKOOL'S properties fit the all-around requirements of the job better than high quality alloy steels. Among other typical applications are lathe centers, indexing cams and medium-stressed spindles where wear resistance is the primary factor.

With down-time doubly dangerous today, check your maintenance department and discover what parts are being requisitioned for constant replacements. The result may surprise you! Then call our nearby representative to discuss AIRKOOL'S possibilities on each job. Free folder TS 201 on request.



COLLAPSIBLE TAP BODY OF AIRKOOL

10½" diameter, 8" thick, weight 25 lbs. AIRKOOL chosen because it gave greater wear resistance on the bearing surfaces. Size changes an distortion was less than .001", and 80% improvement over the case carburized steel formerly used, effecting remarkable savings in costly grinding and lapping.

CRUCIBLE STEEL COMPANY of America

Specialty Steelsmiths to INDUSTRY

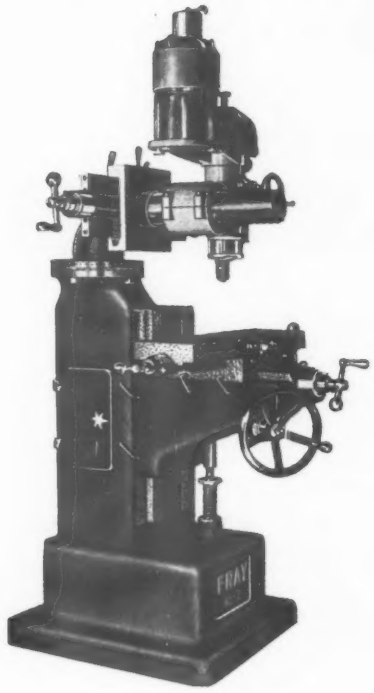
CHRYSLER BUILDING • 405 LEXINGTON AVENUE • NEW YORK CITY

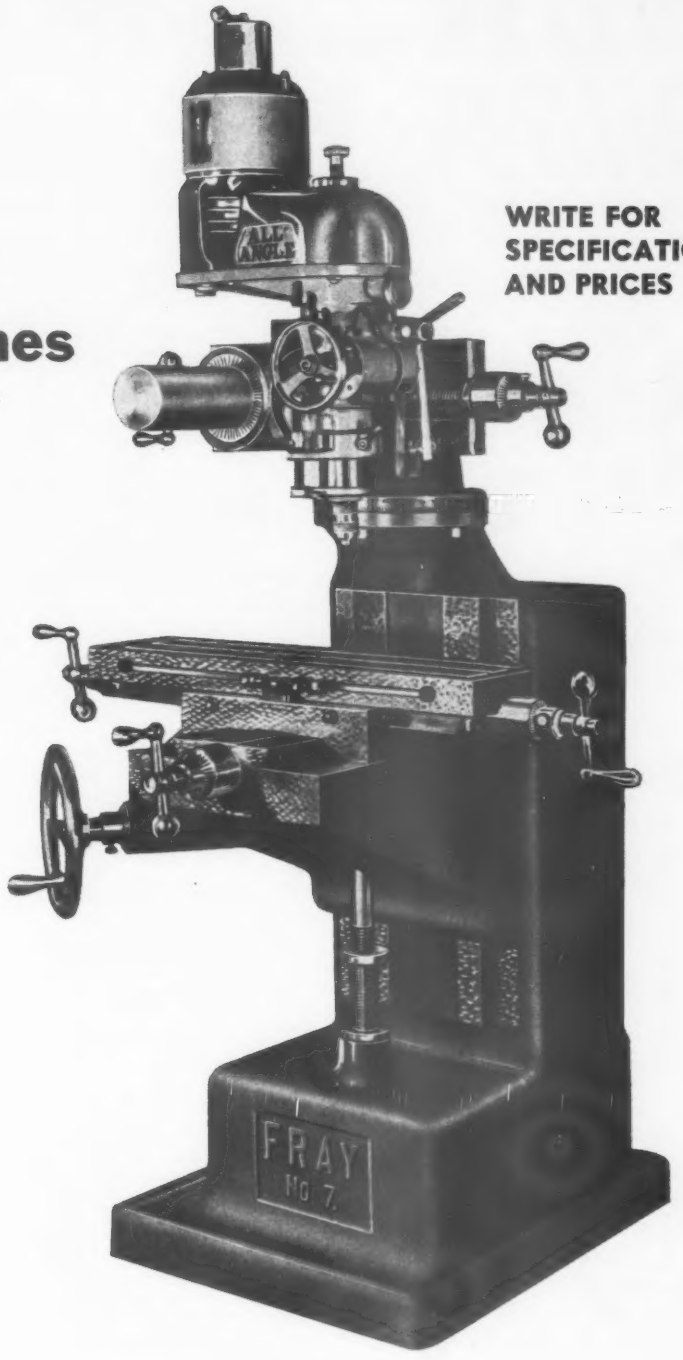
BRANCHES, WAREHOUSES AND DISTRIBUTORS IN PRINCIPAL CITIES

CONSULT TELEPHONE DIRECTORY OR THOMAS' REGISTER FOR NEAREST OFFICE

FRAY

"All Angle" Milling Machines and Milling Attachments





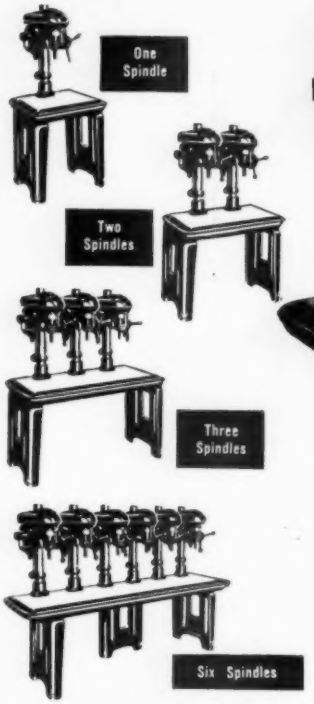
WRITE FOR SPECIFICATIONS AND PRICES

MANUFACTURED BY

FRAY MACHINE TOOL CO.

515 West Windsor Road **Glendale, California**

NOW... make your own Drill Press Combination!



New, Exclusive Delta Machine gives you *as many spindles as you need* — spaced as you need them — at astonishingly low cost!

Designed and developed by Delta, pioneer producers of low-cost production drilling equipment, these new machines now give you just the number of spindles you need for any production setup—two, three, six, eight, ten spindles or fifty—to suit your exact requirements.

Available with 14" or 17" heads—or any combination of both, with Jacob's chucks or No. 1 Morse-taper spindles in 14" heads; Jacob's chucks or No. 2 Morse Taper in 17" heads—high speed or low speed. Completely flexible and remarkably low in cost!

This new type of machine — already in use in many high production plants—gives you an efficient, continuous production line, eliminating transferring between machines — and provides maximum working surface.

Ideal for special setups on long, heavy-work, as sectional table can be made as long as necessary at slight extra cost. Tables are accurately ground and fitted, and the entire unit is heavy, rugged and accurate.

For full details on this new "Tailor-made" drill press development — write us today, telling how many drill press heads you could use on a set-up like this, whether you need 17" or 14" heads or a combination of both, and how far apart you want the heads placed. We will gladly send you complete specifications, prices and any other information you wish.

DELTA MFG. CO. (INDUSTRIAL DIVISION)

680 East Vienna Avenue, MILWAUKEE, WIS.

Delta Manufacturing Company
680 E. Vienna Avenue, Milwaukee, Wis.
Please send us without obligation full information on your new drill press development. We are interested in ..... drill presses on this set up, ...17", ...14", spaced ..... inches apart.

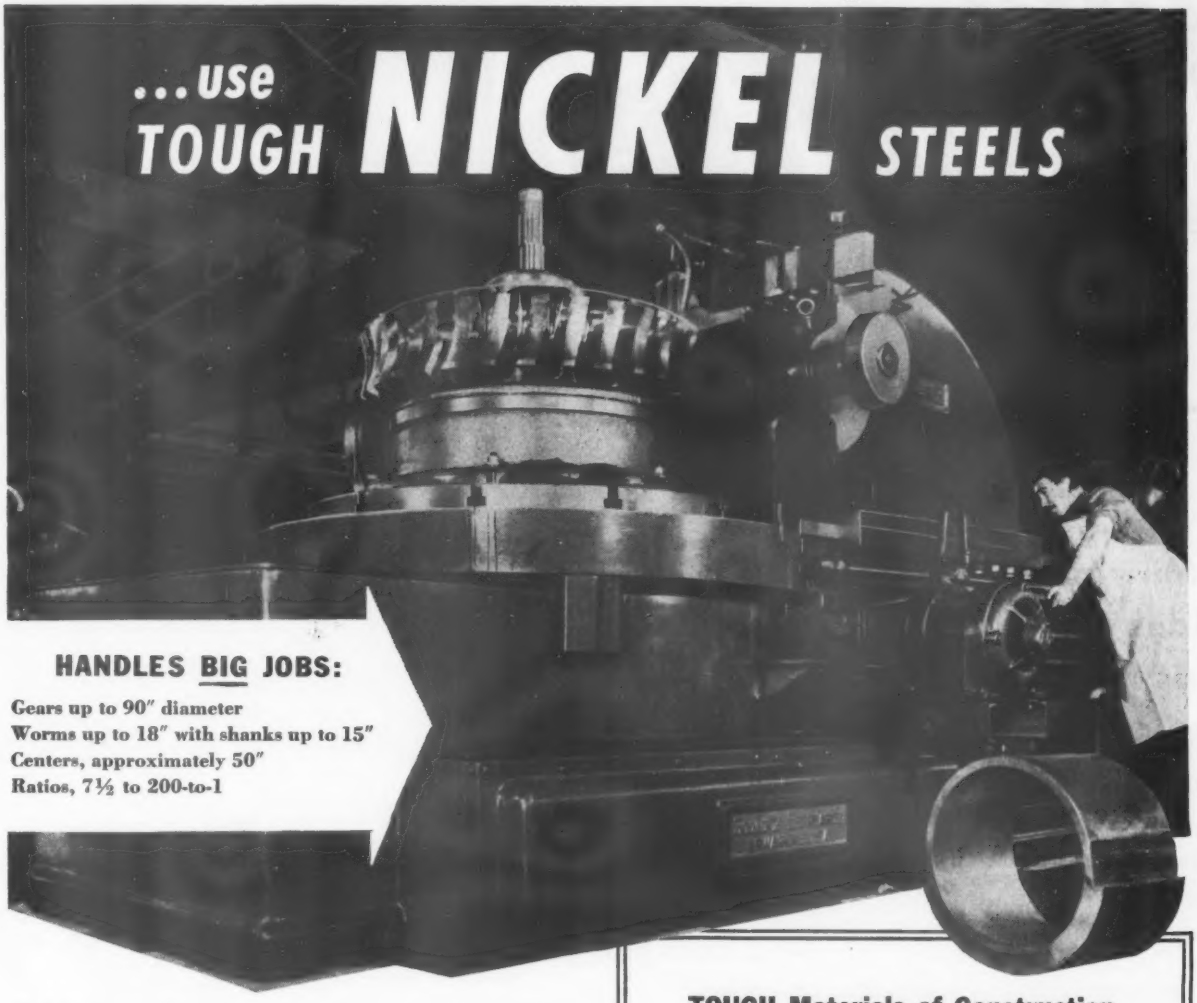
Name.....

Address.....

City.....State.....

SPEED PRODUCTION of speed reducers

...use TOUGH NICKEL STEELS



HANDLES BIG JOBS:

Gears up to 90″ diameter
Worms up to 18″ with shanks up to 15″
Centers, approximately 50″
Ratios, 7½ to 200-to-1

Hobbing machine, built by GOULD & EBERHARDT, NEWARK, N. J., for Michigan Tool Company, Detroit, Michigan, can turn out Cone-Drive gears with diameters up to 90″ and their mating Cone worms with capacities up to 8000 h.p. in a single reduction. Here the hobber is handling a large Nickel bronze speed reducer worm gear.

This gear will be driven by a "Cone" worm of Nickel-chromium-molybdenum steel.

Nickel alloyed materials speed production by providing improved physical properties to maintain dimensional accuracy, minimize shock loads and combat wear. Nickel steels respond uniformly to heat treatment and machine readily even at high hardness. Thus, Cone-Drive worms are machined after—not before—heat-treatment.

TOUGH Materials of Construction Used in New Hobber

Worms are Nickel-chromium-molybdenum steel with tensile strengths up to 150,000 lbs./sq. in.

Index and cutter drive worms, bevel gears, drive shafts and studs are case-hardened Nickel-molybdenum steel, SAE 4615.

Feed clutches are "Hyten M," a tough Nickel-chromium-molybdenum steel produced by WHEELOCK-LOVEJOY & CO.

Gear case, work spindles, bushing and table bearings are Nickel alloy cast iron.

To meet sped up schedules, depend upon tough Nickel alloyed materials. Increased strength of Nickel-containing ferrous and non-ferrous alloys protects against breakdowns and delays. For prompt, practical answers to your metal problems please write, wire or phone to:

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET
NEW YORK, N. Y.

HIGH SPEEDS

mean Smooth, Accurate Work!

The Milwaukee Midgetmill Provides the Necessary High Speeds for Your Small End Mills

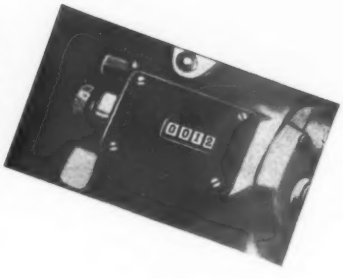
Specially designed to get the most from end mills and milling machines by providing the correct high speeds that mean smooth, clean, accurate work and long tool life — the Milwaukee Midgetmill mills, drills and bores with the utmost rigidity.

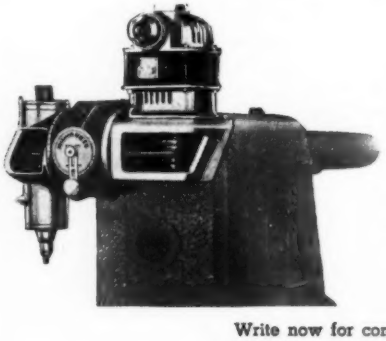
Completely universal — adaptable to any milling machine — fast, safe and easy to set up. Innumerable applications to work on dies, fixtures, metal patterns, templates, etc.

Get full information, send for bulletin — No. 662-A.

KEARNEY & TRECKER CORPORATION
MILWAUKEE **WISCONSIN**

The "THOU-METER"
— exclusive with the Milwaukee Midgetmill. Set cutting tools by direct reading — set dial at zero, and mill, drill or bore until dial shows correct reading — in thousandths. No graduations—no dials—no stops—no binding screws. Accurate to plus or minus .00025 in. in its 2½ in. of travel.





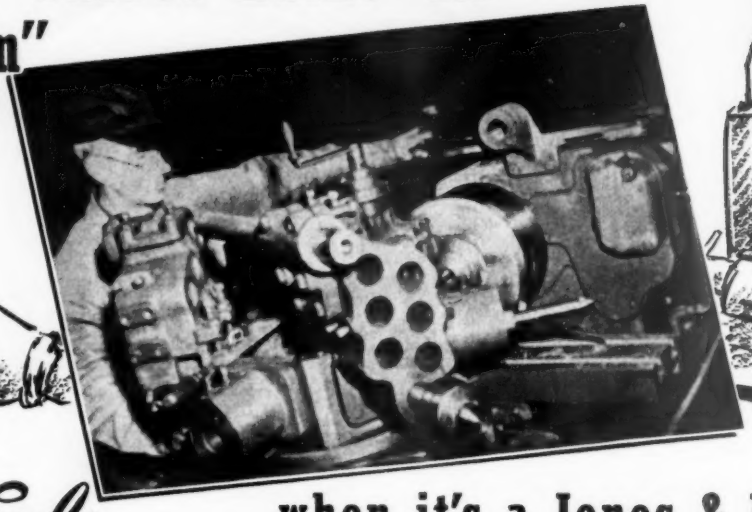
The MILWAUKEE SPEEDMILL
— for end mill speeds up to 5300 r.p.m. Accurate, easy to operate, improved finishes. Adapted to all types of milling machines.

Write now for complete information on the MILWAUKEE MIDGETMILL and SPEEDMILL — built to the same quality standards as Milwaukee Milling Machines.

Products of

KEARNEY & TRECKER CORPORATION
MILWAUKEE MILLING MACHINES

What! A Turret Lathe for "tool room" work . . ?



Certainly . . . when it's a Jones & Lamson, and here are the reasons why!

In the first place, of course, you can do precision work easily on a Jones & Lamson Universal Turret Lathe (within limits of .0005") and get high production also.

But what good is high production when you are only making a few pieces in any lot?

High production still pays on small lots — as you can tell by comparing a week's work on the Jones & Lamson Turret Lathe with a week's work on any engine lathe. The turret lathe makes the *first* piece just as fast, and after that *every* piece is on a production basis; on an engine lathe you'd still be changing tools for every cut.

But does a Jones & Lamson Turret Lathe save enough on small lots to pay for its additional cost?

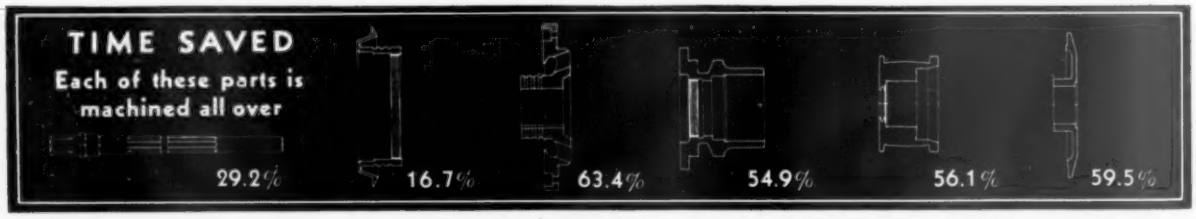
More than enough, and this has been proven repeatedly on shop cost sheets as well as drafting board layouts.

Can you give me an example?

Yes, the diagram below shows a typical group of small lot jobs run frequently in a well known precision shop on new Jones & Lamson Turret Lathes. Note the percentage of time saved per piece, based on the time formerly taken on engine lathes, and you can understand why this manufacturer feels that his Jones & Lamson Turret Lathes are among his most valuable investments.

★ ★ ★

Possibly you too could profit from Jones & Lamson Turret Lathe economies on small lot work. It will not obligate you to write at once, and your inquiry will receive prompt attention.



JONES & LAMSON MACHINE CO.

SPRINGFIELD, VERMONT, U. S. A.

MANUFACTURERS OF: SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS.

PROFIT PRODUCING MACHINE TOOLS

Announced Sept. 3rd—Thousands already in Use!

Industry rapidly adopts—

NEW...CARBOLOY STANDARD TOOLS FOR "UNIVERSAL" SHOP USE ON 80% OF ALL TURNING, BORING, FACING JOBS!

Detroit, Sept. 3.—Mass production on a standardized line of Carboloy tools, designed to cover 80 per cent of all applications for cemented carbide tools, was announced by Carboloy Company, Inc., today.

The introduction of this simplified line of tools—comprising but five styles in three different grades—together with the economies resulting from mass production, has made it possible to price these complete tools well below comparable tools in the past, a typical new 'standard' tool, Style 4, now priced at only $1.85, comparing with tools previously costing $5.84 in lots of one. In quantities of 50 or more this typical tool now costs only $.90.

The program that has made this unprecedented step possible has been under development for the past three years. In the period from 1929 to 1937 prices of Carboloy cemented carbide

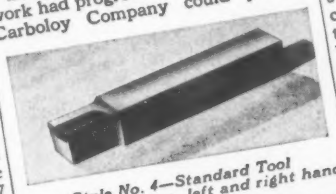
Style No. 1—Standard Tool
Available in 9 sizes

were progressively reduced four times as the result of economies resulting from increased consumption. About that time it became apparent that to widen the scope of useability of Carboloy tools required a complete revision of the principles under which such tools had been produced and sold up to then. What was needed was mass production of complete carbide tools on a scale never before attempted in this country.

Since 1937 extensive research work in the laboratory and in the field has been devoted to determining the fewest number of 'grades' of Carboloy and the simplest line of tools that would meet the vast majority of all carbide tool applications.

New $1,000,000 Plant Part of Program

Early in 1938 this development work had progressed to a point where Carboloy Company could proceed

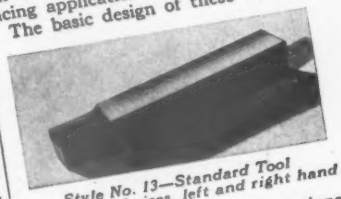


Style No. 4—Standard Tool
Available in 9 sizes, left and right hand

with its next step—the expenditure of a million dollars on a new plant and equipment to expand and concentrate manufacturing activities. This plant, completed in the spring of 1939, was designed with a production capacity of ten times the amount of cemented carbide then consumed by industry, with provisions for expanding metal production to many times that amount.

Since that time, research and field experimental work has resulted in reducing the number of grades of Carboloy required for the vast majority of applications to only three —one new grade for steel cutting, and two for cast iron. Further, it was found that five styles of tools in each of these grades would cover 80 to 90 per cent of all turning, boring and facing applications.

The basic design of these tools is



Style No. 13—Standard Tool
Available in 5 sizes, left and right hand

such that several hundred variations can be rapidly ground in the tools by the user to meet special requirements. With the fast, simple grinding procedure developed during the past five years and now widely used by industry, such tool changes can be rapidly and economically accomplished. This rapid grinding procedure, plus the fact that the price of these new standard tools is comparable to that of many ordinary tools, brings to the field of Carboloy tool use a flexibility that permits broad 'universal' use of these tools within the average shop on short job-lot work as well as production runs.

The new standardized tools are carried in stock, ready for shipment, completely ground and ready for use. An extremely valuable feature is the incorporation of a ground-in chip breaker on all standard tools designed for the machining of steel, at no additional charge.

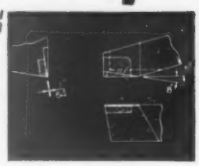
The new program, according to the announcement, is anticipated to produce a wider scale use of carbide tools, thereby reducing the cost of produc- [illegible] of basic cemented carbides to [illegible] that in spite of higher [illegible] cost.

Carboloy Announces 6th Price R[illegible]

Since the year when Carboloy tools were first introduced it has been [illegible] Carboloy Co[illegible]

For a number [illegible] have realized tha[illegible] reducing the p[illegible] lev[illegible]

- ✓ LOW PRICED! *(Check against any other cutting tools)*
- ✓ SIMPLIFIED ORDERING!
- ✓ SIMPLIFIED TOOL STOCKS!
- ✓ IMMEDIATE SHIPMENT!
- ✓ YOU GET THEM ALL GROUND READY FOR USE! *(Steel cutting tools furnished with ground-in chip breaker)*



Example of chip breaker ground in steel cutting tools.

Have You the Facts?

WRITE FOR CATALOG GT-125

CARBOLOY COMPANY, INC.

11145 E. 8 MILE RD., DETROIT, MICH.

Chicago • Cleveland • Newark • Pittsburgh • Philadelphia • Worcester, Mass. • Los Angeles

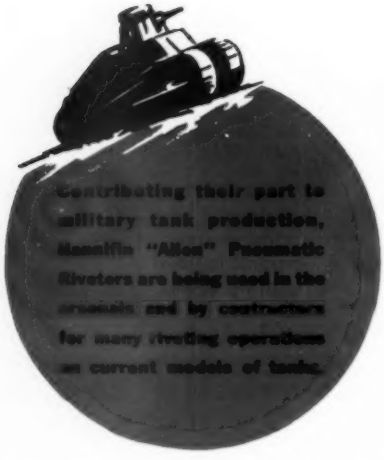
Canadian Distributor: Canadian General Electric Company, Ltd., Toronto

CARBOLOY REG. U. S. PAT. OFFICE

TANTALUM CARBIDES
TITANIUM CARBIDES
TUNGSTEN CARBIDES

HANNIFIN

"ALLEN" PNEUMATIC RIVETERS



UNIVERSALLY ACCEPTED among leading users in structural, railroad, and boiler shops, ship building, and industrial plants, Hannifin "Allen" pneumatic riveters deliver smooth-acting, efficient riveting performance. There is a type and size for every need in both hot and cold riveting. Nineteen standard sizes of jaw type riveters are available, capacities up to 1¼ inch hot structural rivets. Other Hannifin "Allen" pneumatic riveters available are compression lever, alligator, and stationary models. Write for Bulletin No. 43 with complete specifications of all types.

ALLEN RIVETER DIVISION

HANNIFIN MANUFACTURING COMPANY

621-631 SOUTH KOLMAR AVENUE, CHICAGO, ILLINOIS

Detroit representative: R. A. Bean, Hayward Building, 4929 Woodward Ave., Telephone Columbia 4949

WORLD'S LARGEST MANUFACTURERS OF SQUEEZE RIVETERS

The Tool Engineer

America in the Making

RECENTLY we were urged by a book reviewer to buy a novel of the Old West which was laid "in those stirring days when America was in the making."

It seems to be a national complex: When America *was* in the making.

We refuse to subscribe to any such sentiments because we know that America *is* in the making. It would hardly seem worth while to repeat a truism grown trite with time had we not been confronted with this new example of the "finished" complex.

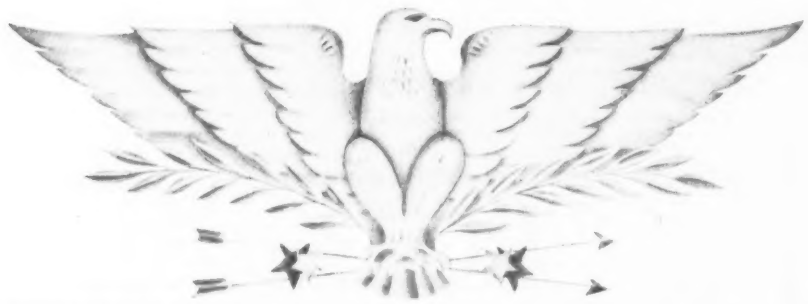
We have, it is true, expanded geographically to our limits, and the tale of that growth is truly stirring. But like the rushing waters of a river denied one course, which swirls and rises until it finds another, the pioneer spirit is not bottled up. And unlike the geographical lines, the industrial and scientific frontiers upon which men fight today appear still to be limitless.

There have always been those who were content to live in the shadow of the great past, to thrive on what they once were; but such people are not the sinew of a dynamic America. Ours is still a young, courageous, precedent-breaking land which lets the dead past bury its dead as it turns its eyes ever towards tomorrow.

And in the vanguard of these new pioneers we find Tool Engineers starting across uncharted sands to new production methods and hacking through tangled jungles of ignorance as they seek to build a new and better life for all the people.

Let him who ten years ago said progress was finished never drive a car with metal top and hydraulic brakes, never fly through the stratosphere in a plane equipped with absolute altimeter, never watch a televised hockey match or read a newspaper containing wirephotos, never shave electrically nor regain life in the friendly confines of an iron lung, never streak across the west in a Diesel streamliner nor relax in dust-free, air-conditioned comfort in his own home; never, in short, do any of the million and one things which, though some may have had their start earlier, have begun to come within the ken of the people only during the past decade, and only because on a thousand fronts Tool Engineers were striving for new ways to produce more for less, were seeking new applications for old machines and new machines for old applications, were building the sound tooling foundation from which all production progress rises.

And as this fourth decade of the twentieth century draws to a close, we cast one prideful glance backward before turning to face the future. We are proud to be in the position of reporting first hand the work of the Tool Engineer, for we know that in peace and in war, in prosperity and in depression, America will move forward across its industrial frontiers during the next decade as it has in the one just ending. We look with pride upon our profession because we know that the story of the Tool Engineer, which we are writing from month to month, is the story of "America in the making."



This workman is using a 5/16–24 "G.T.D. Greenfield" Ground Thread Tap—turning it with a "G.T.D. Greenfield" Tap Wrench, and testing the hole with a "G.T.D. Greenfield" Plug Thread Gage.

Here's a Tough Job!

This looks like aluminum—actually it's chrome molybdenum steel, No. 4823, tensile strength, 180,000 lbs. It's an elbow assembly for aeroplane landing gears and production conditions require a hand operation with precision ground thread taps. We are told that production is only 60 holes per tap, and taps have to be sharpened after every 10 holes. Pretty low? Well, before "GTD Greenfield" taps were used the production was only 35 holes per tap with 6 holes between grinds.

The fact that "*Greenfield*" taps excel on extremely tough assignments is extra assurance that they will turn in equally superior performances on easier jobs. Don't you want to arrange a test?

For Accuracy: "G.T.D. Greenfield" Precision Ground Taps and Precision Thread Gages.

GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass.

Detroit Plant: 2102 West Fort St. Warehouses in New York, Chicago, Los Angeles and San Francisco. In Canada: Greenfield Tap & Die Corp. of Canada, Ltd., Galt, Ont.

GTD GREENFIELD

TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

"Carrousel"

by

H. L. LUNDSTROM, *Superintendent, and* A. A. NICHOLS, *Engineer*
W. H. Nichols & Sons, Waltham, Mass.

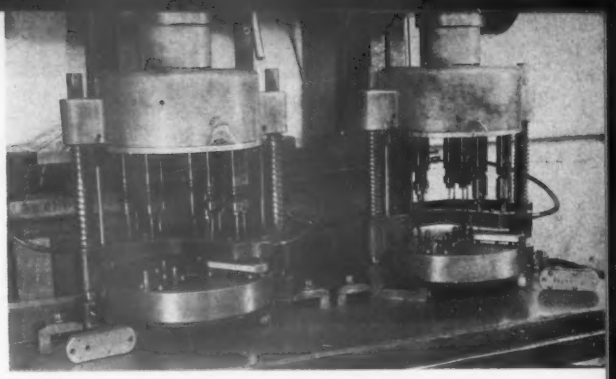


Fig. 2. Groups of Spindles
Distinctly a production tool.

MANY tool designers are faced with the problem of drilling, counterboring, reaming and redrilling in successive operations, and on large lots of identical pieces. To do this job in the face of the present increasing shortage of machine operators, and to do the job economically, the "merry-go-round" drill jig is very useful. Examples of this type of jig are shown in the photographs on this page.

Each of these jigs consists of three elements, stacked one on the next, and the whole mounted in a power fed drill press of suitable size. If a two, four, or six spindle drill press is available, the operator may be able to do tapping or burring in adjacent spindles while the power feed is engaged on the "merry-go-round".

Three Elements Described

The uppermost of the three elements referred to above is the multiple spindle head (made by several reputable firms throughout this country), which simply distributes, by spur gearing, the drive from the main drill spindle to a number of small drill spindles arranged in the proper positions for the job in hand. This arrangement may be in the simplest case *(Figure 1)* on the corners of a triangle, square, pentagon, or other regular figure, where the operations are performed on one hole only of the work. *Figure 1* shows the spindles arranged on corners of a hexagon, one spindle omitted for loading position. The second and more complicated arrangement is where *groups* of spindles are arranged around each of the corners of the triangle, square, or pentagon, and is illustrated in *Figure 2*, which shows a group of spindles arranged about each of the corners of a square, with one group omitted for a loading position. The gearing in this head may be laid out for the proper speed for each small spindle according to the tool therein. The head is equipped with bushed lugs for aligning with the lower elements.

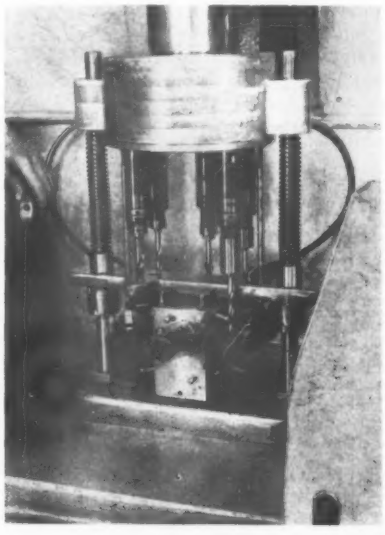


Fig. 1. Single Spindles
The lowest element provides the name.

How to get high production in successive drilling operations when machines are scarce: the merry-go-round jig.

The next element beneath the multiple spindle head is the jig bushing plate, which is bushed to slide on the vertical guide pins, and retain a fairly accurate relation to the multiple head, and the work. The bushing plate is the most accurate element, and fulfills two important functions; first, it locks itself to the work carrying plate by means of lock pin bushings, and second, it carries the drill jig bushings which locate the initial work of the drills and reamers. The jig is usually planned so that those operations which involve large chip volume are carried out without hindrance of a jig bushing. For instance in *Figure 1*, there is but one jig bushing in the spotting position, all other operations (in this case drilling by steps a hole 2¾" deep in stainless steel) being carried on in the open. Likewise, in *Figure 2*, the spotting drills and sizing reamers are guided by bushings, but the through drills operate in large holes through the jig plates. A secondary purpose of the jig plate is to distribute coolant by means of internal drilled passages, ending in small nozzles at each drill, and fed by hose from the main pump.

The lowest element of the "merry-go-round" is the work holder, from which this jig gets its name. The work holder has locating points for the work (nicely shown in *Figure 2*), upstanding bullet pins for locking itself to the jig bushing plate, a central pivot, and can whirl merrily on a row of ¾" steel balls tucked away under that smooth skirt shown in *Figure 2*. The steel balls are retained in a turned Vee groove in the base plate. Base plate also carries the two pillar posts.

Method of Operation

The work is clamped in *Figure 1* jig by a knurled knob and strap. In *Figure 2*, clamping is automatic on the down feed by reason of the springs on the pillar posts, which urge the jig bushing plate against the work.

The *Figure 1* jig operates as follows: load in empty position; index to No. 1 work position, where large drill (same size as counterbore) spots and drills approximately ¼" deep; index to No. 2 position where tap drill goes in ¾" deeper than spot; index to No. 3 position where counterbore squares out bottom of No. 1 hole; index to No. 4, where tap drill goes in ¾" deeper; index to No. 5 where tap drill completes hole depth. A new work piece is added at each indexing. Results have shown that there is less tendency for a deep drilled hole to wander off line when drilled in stages by *several* drills than if drilled by stages with a *single* drill.

The *Figure 2* jigs operate on a similar cycle, the left hand jig (1) spot and drill body size, (2) drill tap size (3) ream body size: and the right hand jig (1) spot and drill body size (2) ream body size (3) counterbore for head of screw. Work pieces are shown to left and right respectively of the jigs.

"Merry-go-round" jigs are distinctly production tools, and are well worth their cost because they will get the work out without tying up many expensive main drill spindles and machine operators. Production in SAE 51335 stainless steel from jig 1 is 3000 operations or 600 pieces per eight hour day. Production from jig 2 (either one of the two) is 9600 operations or 800 pieces per eight hour day, without too much hustle.

SHELL HOLDING EQUIPMENT

Air and Hydraulically Operated

By JOHN C. COTNER
Chief Engineer, Logansport Machine, Incorporated
Logansport, Indiana

OUR National Program of "Preparedness for National Defense" has created the urgent need of most efficient and economical methods for the production of shell forging. Constant development of the necessary work holding equipment is necessary to provide work holding means comparable to the present-day manufacturing procedures. In this development both air and hydraulically operated devices are being furnished and developed.

While there are certain established standards in the manufacture of shells, there are still many various procedures and means of machining shells which require various types of work holding equipment to meet the requirements of all the various methods. The illustrations shown in this article are intended to illustrate the various types of shell holding equipment in general use in many industrial plants manufacturing shells. The illustrations cover only those primary ideas of shell holding equipment that may successfully be used while performing the many operations necessary to produce shells.

The Machine Tool Industry is constantly developing new and better machines which alter operation procedures and methods of performing the various machining operations. Therefore, it would be unwise to establish any definite program relative to a standard line of work holding devices required for producing any particular shell.

The essential shell holding equipment necessary to produce machine shells is as follows:

1. Six-Jaw Expanding Mandrel
2. Three-Jaw Expanding Mandrel
3. Parallel Grip Collet Chucks
4. Three-Jaw Chucks

Any of the above work holding devices can be satisfactorily operated by either air or hydraulic equipment.

A brief resume of shell holding operation is given in the general order that the operations are performed:

Six-Jaw Mandrel for Centering

Centering of the shell is usually the first machine operation performed on the forging. It must be carefully performed to insure concentricity so that on succeeding operations the shell will be held within the limits specified for manufacture. The forging is placed on the Six-Jaw Expanding Mandrel (Figure 1) for performing the centering operation. In this mandrel there are two sets of three expandable jaws set longitudinally with the shell as far apart as possible to grip upon the straight portion of the shell so as to center the shell accurately with either the forged or machine hole of the shell. Both sets of jaws are expanded by either air or hydraulically operated cylinder and this cylinder is attached to the spindle to float so as to give both push and pull action so that equal pressure is exerted on each set of jaws. The shell forging is located against the work locator in the mandrel for endwise location.

Three-Jaw Expanding Mandrel

The operation usually following the centering is that of rough machining the base, cutting off to length and rough turning for concentricity. This operation is performed generally on a multitool lathe with movable tail-stock, the center quill of which is air or hydraulically operated. The Three-Jaw Expanding Mandrel (Figure II) is used to drive the shell at the open end and the closed end is supported by the tailstock center. In this mandrel the work locator is a separate unit and is slipped into the shell forging before the shell is located on the Three Jaw Expanding Mandrel. By means of this separate locator unit the tailstock movement is only that required to permit the shell to be removed from the short three-jaw mandrel. If the locator were a permanent part of the three-jaw mandrel, it would be necessary to move the tailstock the entire length of the mandrel and locator before shell could be removed. This work locator is adjustable so that the shell can be properly located in relation to the tools and the required thickness at the closed end of the shell. This type of Three-Jaw Mandrel with the separate work locator is generally used on large, heavy shells.

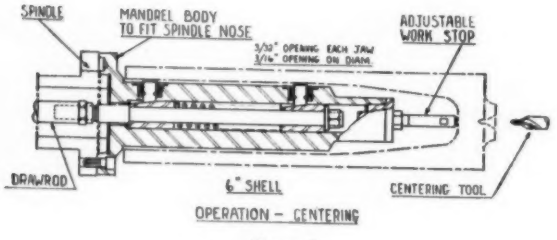


Figure I

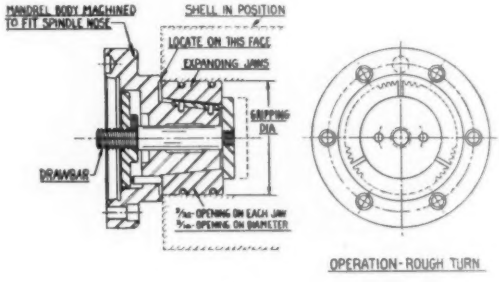


Figure II

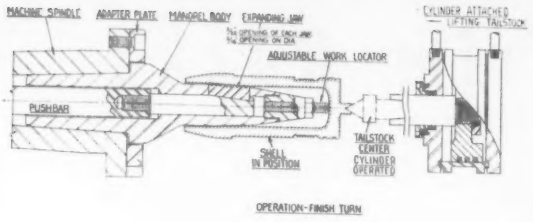


Figure III

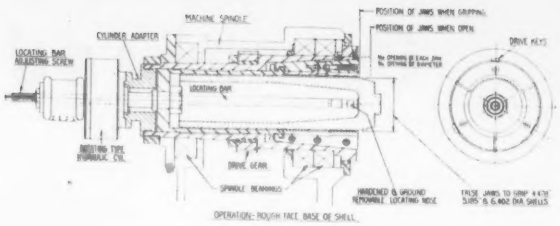


Figure IV

Three-Jaw Expanding Mandrels are made with the work locator as an integral part of the mandrel and the mandrel shown in Figure III is of this construction. This is for use with small short shell forgings where the tailstock movement would not be beyond the usual practice.

Parallel Grip Collet Chucks

The use of parallel grip collet chucks in shell manufacture is quite general and there are several general designs which may be used for application to new machines or re-built machines. The collet chuck shown in Figure IV is made a part of the machine spindle with the spindle acting as the body of the collet chuck and the master jaw collets closing and operating within the spindle.

This type of collet chuck has been successfully used on base facing machines where it is desired to reduce the overhang to a minimum.

Figure IV also illustrates the use and application of air hydraulic cylinders for operating collet chucks. The cylinder is attached to the spindle by suitable adapter means and is connected to the collet chuck by a suitable draw bar. The actuation of the piston in the cylinder opens or closes the collet chuck. An adjustable work locator was also incorporated through the cylinder in this application so that the adjustment of the locator could be effected from the rear of the machine.

Figure V illustrates the application of collet chucks attached to the spindle nose of the machine and projecting beyond the spindle. This is the most ordinary application and where the collet chuck is of any great length, suitable steady rests or outboard supports are provided to help support the collet chuck. Chucks of this type are generally used for boring operations, banding operations, band turning, weight making, etc.

Power operated three-jaw chucks have been used successfully in holding large shell forgings for boring operations, facing the length, weight making, etc., and the Three-Jaw Chuck shown in Figure VI is illustrative of this type of work holding equipment.

Air operated shell holding devices are used on the machining operations of small shells or light machine operations of large shells. Hydraulically operated equipment due to the higher pressures available is used on the machining operations of medium and large size shells and by the combination of these two operating mediums, successful work holding devices are today available to successfully hold shell forgings in today's very high productive machine tools. There are several manufacturers today who are in position to engineer and manufacture successfully shell holding equipment for all requirements.

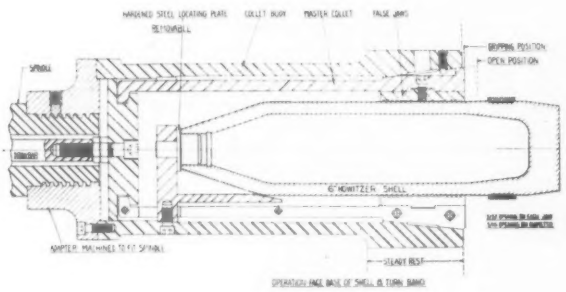
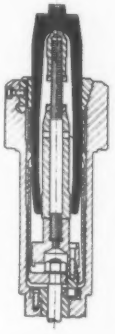


Figure V



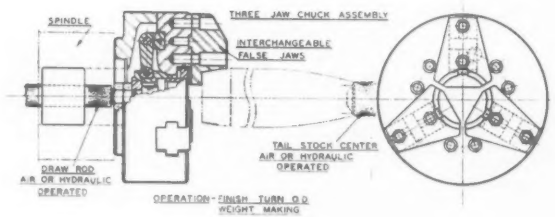


Figure VI

Fig. 7

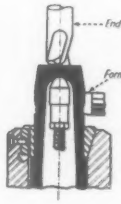
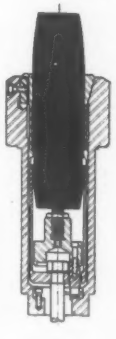


Fig. 8

Fig. 9



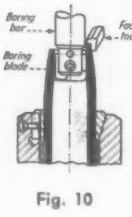


Fig. 10

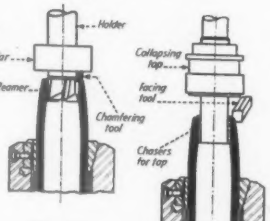


Fig. 11

Fig. 12

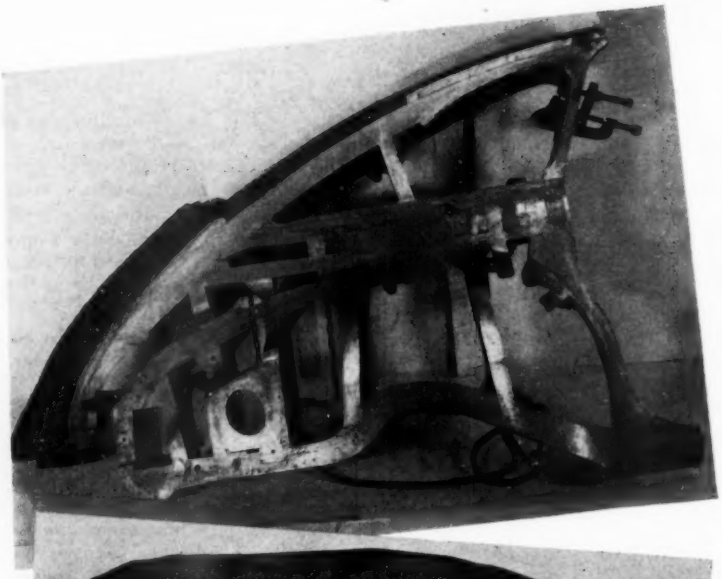
At right are illustrated the operations where collet chucks are used to hold the shell forgings. While these operations are not in the sequence of the operations on the shell, they indicate some of the operations performed while the shell is successfully held by the collet chuck. In the three small sketches at top, left to right: Rough face the base of shell, form band seat and remove boss, finish face base. In the three small sketches at bottom, left to right: Finish face and bore mouth, ream and chamfer mouth, tap and finish face mouth.

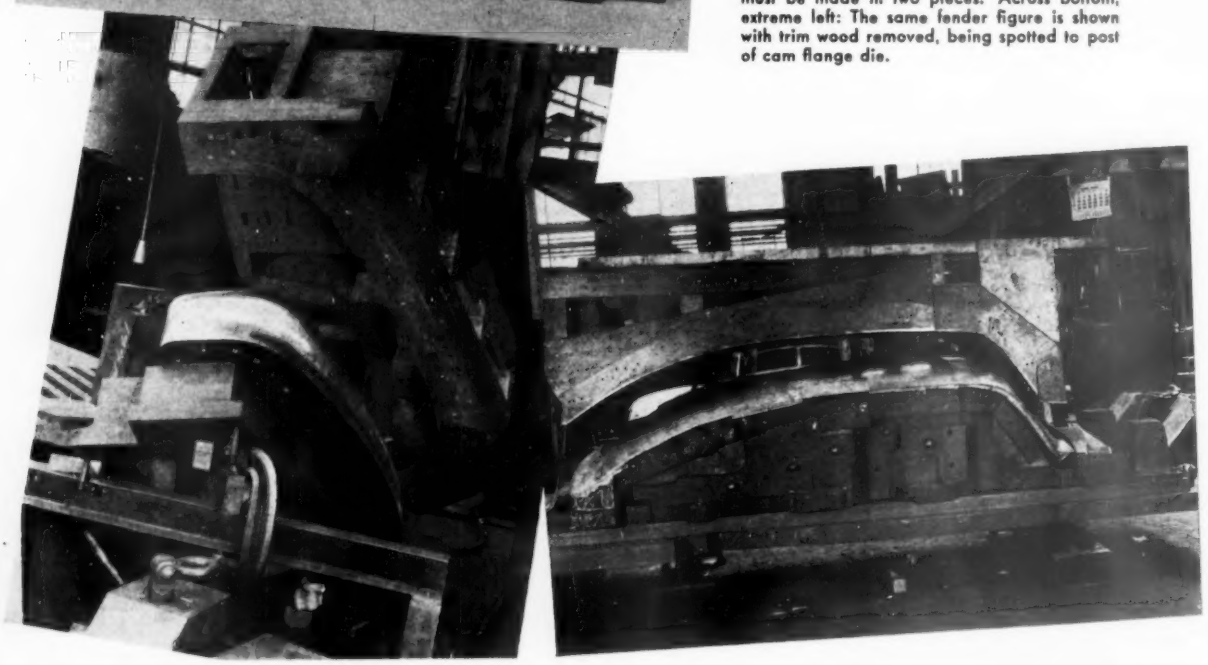
Cerrobend Trim Racks

by
T. M. CURTIS
Curtis Industrial Designing Engineers
Detroit

PROGRESS in the design and construction of dies for large stampings of the automobile type has been relatively steady since the development of Keller engraving machines two decades ago. With their applications a great step forward was made to produce contoured work more expediently with less labor and at the same time, more accurately.

During the past few years, however, with the use of a new metal, "Cerrobend", another great forward step is taking place in the die building industry to





Upper left: A quarter panel trim rack. Note the loose pieces mounted on the side of the fixture, carrying the developed trim line, the flange line, moulding holes, fender mounting holes, gas tank opening hole, bumper opening hole, and wheel house mounting holes. Center left: A rear fender trim rack and spotting fixture showing trim line mounted on loose pieces. Note development of notches and fender mounting lugs on fixture, body side flange line, moulding mounting holes. Due to the fact that the nose of this fender has back angle, fixture must be made in two pieces. Across bottom, extreme left: The same fender figure is shown with trim wood removed, being spotted to post of cam flange die.

How to reduce die construction costs and save tryout time through the use of a new material for trim racks and spotting fixtures.

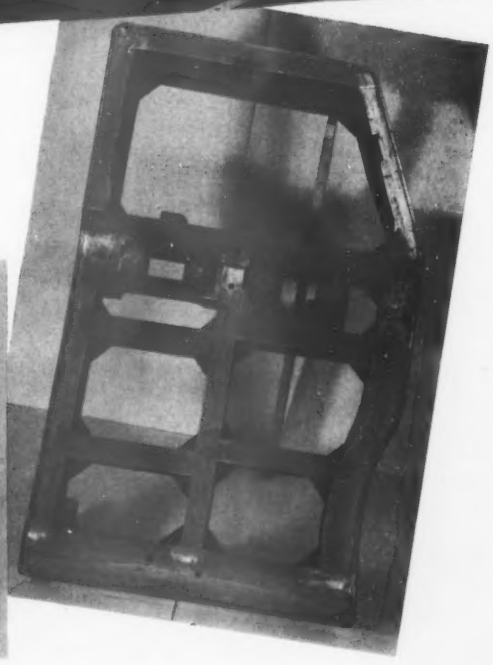
again reduce die construction costs, save tryout time, and eliminate production troubles, while at the same time, producing more accurate dies.

Cerrobend, (woods metal) an alloy of bismuth, lead, tin, and cadmium, has the extremely low melting point of 160°F., much below the boiling point of water. It is extremely fluid in the molten stage, even resembling mercury. Upon solidification it has the tensile strength of 5,990 pounds per square inch, a Brinell hardness of 9.2, and weighs .339 pounds per cubic inch. The above qualities show that it is a relatively hard metal, will stand abuse, and in addition, a perfect duplicator of surfaces with which it comes in contact. The metal does not shrink during solidification.

To understand the usefulness of die fixtures to the die industry, it would be well to analyze the methods by which large stamping dies have been made in the past. For example: a quarter panel trim and pierce die for automobile side quarters was built after the draw dies were completed and stampings made. Trim lines were developed on the stampings, holes were laid out similarly, and the die posts were usually spotted from the sheet metal stamping that was made in the draw die or plaster casts, neither being a very accurate reproduction of the master model. This long and tedious process was carried out for lack of a better method. Cerrobend type trim racks and die fixtures fill this need satisfactorily, quickly, and accurately.

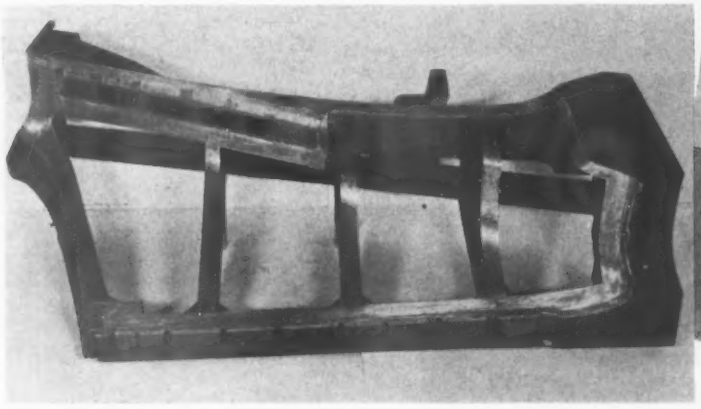
Originally die fixtures were made from the master model by hand spotting sections of mahogany to the male model, and then fastening together the various portions thus formed. When assembled the entire female fixture was again hand spotted and fitted to the master model. This method of making checking fixtures is both time consuming and expensive, and the fixtures made in this manner are not as accurate as is frequently required, because there are too many possibilities for error when each portion of the checking fixture has to be independently shaped by hand to fit it to the master model. In many cases these checking fixtures are as expensive as the models themselves. From this beginning the Cerrobend type die fixtures made its start.

A wood frame, usually mahogany, sometimes made of angle iron construction, comprising of longitudinal and transverse members, having a general contour of the master male model is fab-



At bottom center left: This illustration shows one of the largest die fixtures ever made. It is for a 1941 roof tip panel which included everything from front of cowl to the back of car. The fixture is being spotted to the large expanding type flange die. At bottom center right: A hood top spotting fixture with notches developed on trim wood all around. Also note louvre holes located in fixture flange line. At bottom extreme right: An outer door panel trim rack and spotting fixture. Note trim line developed on loose pieces, notches at corners, and hinge moulding and handle holes. Upper right: This illustration shows the hood fixture below being spotted in the die.

All Photos Courtesy Koestlin Tool & Die Company



ricated and is made to fit the same male model to approximately ¼ inch to ⅜ inch away from the surface of the model. By sealing outside surfaces and providing holes through the frame, Cerrobend metal is introduced into the spaces that has been provided for between the model and the surface of the fabricated fixture. The Cerrobend is poured in the molten stage at its characteristically low melting point, and is permitted to solidify against the roughly fabricated frame. The surface of Cerrobend will reproduce accurately the shape and contour of the master model. This is the general procedure in the manufacture of Cerrobend type die fixtures. Today, such companies as Castaloy Die Fixture and Engineering Co. in Detroit have gone farther in their development. By developing trim lines or run offs on the model a trim line is reproduced on the die fixture. Holes are located by means of sheet metal templates in proper locations, (as shown in photographs) flange lines are developed, locaters are mounted for the use of subfixtures to the main trim rack.

By the use of one fixture a whole series of dies may be made with a definite assurance that when these various dies are spotted to the trim rack they will be uniform in shape and contour. Trim dies can be built and finished at the same time draw dies are being made. The human element of error is greatly reduced when the die maker must work to a fixture that carries all his important information in the position which he needs it. The use of die templates to a great extent is eliminated in the construction of large dies. This alone is a tremendous saving when one considers the number of die templates which have been made in the past just for the construction of the dies, then discarded. The finished stampings are more accurate, reducing assembly problems to a minimum. And finally, since the metal can be used over and over again, there is little expense involved in the building of a series of dies with trim racks.

Regional Organization Adopted by A. S. T. E.

With the formation of several new chapters and the addition of over 1000 new members in the past six months, climaxing a spectacular growth over a period of the past four years, the American Society of Tool Engineers has been organized into regions to facilitate administration, according to an announcement from the Board of Directors.

Each region will consist of two chapters, with 19 regions for the current 38 chapters of the technical society. Directors hereafter will be elected from regions instead of Chapters, reducing the total number of Directors.

Furthermore, election of Directors will be for a period of two years, with half of the regions electing Directors one year, and half the second year. For the coming year, half of the regions will however elect Directors for one year only, electing Directors again the second year. In this manner an overlapping of half of the directorate each year will be obtained, facilitating continuity in administration of Society affairs.

Advisory Committee on Defense Training Appointed

WASHINGTON — Appointment of an Advisory Committee to the U. S. Office of Education on Engineering Training for National Defense was announced by John W. Studebaker, U. S. Commissioner of Education.

Members of this Committee represent leading engineering schools and colleges and will advise the U. S. Office of Education on matters of policy affecting the national defense training program in engineering schools are headed by chairman Andrey A. Potter, Dean of Engineering, Purdue University.

Commissioner Studebaker also announced the appointment of Allen W. Horton, Jr., to the U. S. Office of Education staff as Specialist in Engineering Education. Mr. Horton will devote full time to study of problems of national defense training in engineering schools. He will be secretary to the newly-appointed Advisory Committee on Engineering Training for National Defense.

HIGH PRECISION—HIGH SPEED

Manufacturing Automatic Chucking and Turning Machines

Anti-friction bearings in headstock.

Levers for automatic four spindle and three feed changes may be hand-operated while setting up.

Main clutch lever.

Spiral gearing and shafts chrome nickel steel heat treated, running in oil.

Feed start and stop lever.

Conveniently-placed fast motion lever.

Spindle equipped with automatic stop.

POTTER & JOHNSTON

5D 2-9" 2-12" E2-15"

These famous TWO-SPINDLE models incorporate features which make for extreme flexibility and unusual accuracy in high-quantity production. Many of the modern constructural features listed here account for the brilliant performance of these machines, and a fair understanding of their capacities and capabilities can be obtained by studying the features indicated by the arrows. For complete specifications and delivery dates, write to your nearest agent.

Cross slide longitudinal adjustment.

Hardened and ground steel ways.

Large turret in taper seat, automatically clamped after indexing.

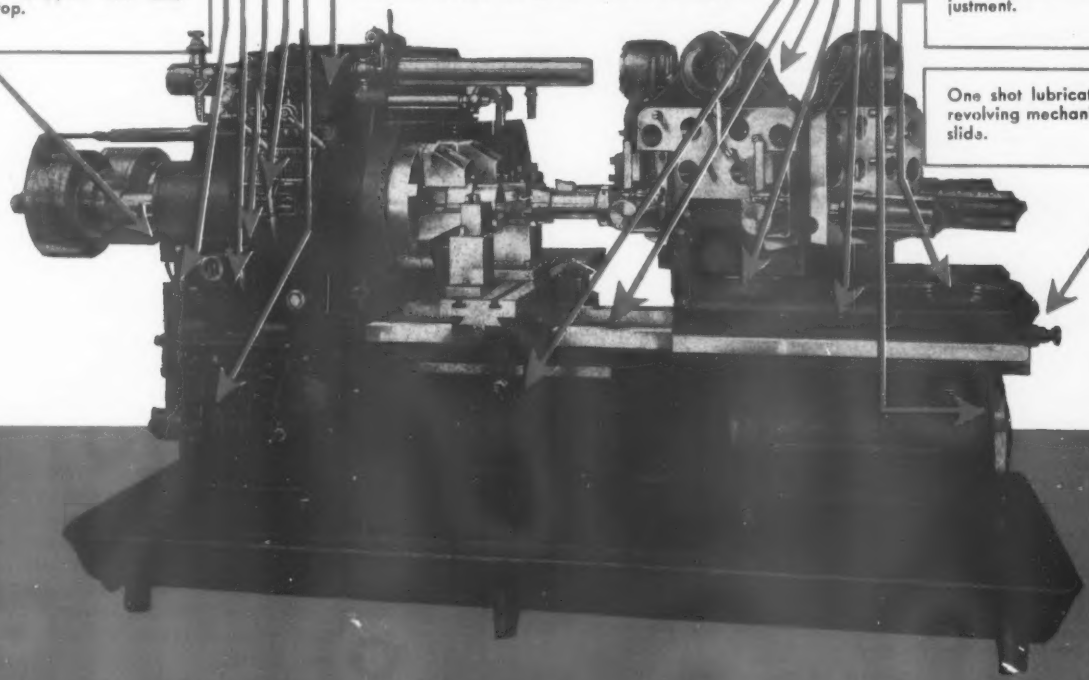
Turret Geneva revolving unit of alloy steel, heat treated.

Turret Slide Travel 9" machine, 11⅝"; 12" machine, 13" or 16"; 15" machine, 13" or 16".

Turret drum revolves on Timken Roller Bearings.

Clamp bolts for turret slide adjustment.

One shot lubricating for turret revolving mechanism and turret slide.



POTTER & JOHNSTON MACHINE CO.

PAWTUCKET, R. I., U. S. A.

Tooling For Defense Theme of Exhibition

Space Reservations for Machine and Tool Progress Exhibition Break All Records

DETROIT — "Tooling for Defense" will be the theme of the 1941 Machine and Tool Progress Exhibition of the American Society of Tool Engineers, Ford R. Lamb, Executive Secretary of the Society, has announced. Space reservations have been made at a surprising rate and response to the first announcement was so great that it was necessary to make an additional layout almost immediately of another section of the hall. A great many former exhibitors have reserved larger spaces than at previous Exhibitions.

The 1941 Show will be highly significant in relation to the Defense Program because of its educational nature in tooling for defense production—the theme that will be stressed in exhibits and technical sessions. With a pronounced shortage of Tool Engineers for tooling the defense program and because of the length of time required to train them, it is important to make those now on the firing line as efficient as possible. One way of doing this is by providing a means whereby they can see and examine most of the latest machines, tools, processes and methods of production, and where they can ask questions about defense methods.

Government Agencies To Participate

Several government agencies have expressed an interest in this activity and it is expected that they will be on hand to help Tool Engineers from all parts of the country in getting a better understanding of Defense Problems. New armament aids will be exhibited for the purpose of showing the production requirements incident to their production. These will include such items as aircraft motors, sub assemblies, and fuselages, tank parts, and gun carriages.

The production of aircraft, both motor parts and fuselages, will be the theme of one of the technical sessions. Another will be devoted to naval needs, while a third will deal with the educational requirements of Defense.

A preview session will deal with Ordnance Requirements and the annual meeting of the American Society of Tool Engineers will offer a solution to the training problem.

The exhibition comes at a time when most of the manufacturers of machines, tools, fixtures, accessories, and materials are extremely busy. In spite of these conditions industry has stepped right into the picture ready to do its part in an activity which will lend impetus to our defense work through education.

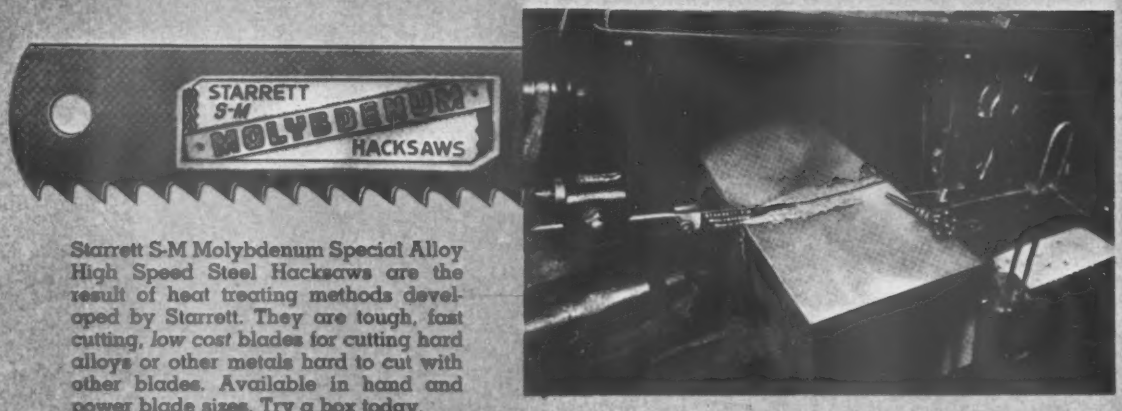
The Machine and Tool Progress Exhibition will again be held in Detroit's mammoth Convention Hall, March 25th through 29th, 1941.

To assist the nation's industries in training apprentice mechanics, particularly in connection with defense work, the various chapters of the American Society of Tool Engineers, are organizing local educational committees to cooperate with manufacturing plants, trade schools, etc., in their area in coordinating training efforts.

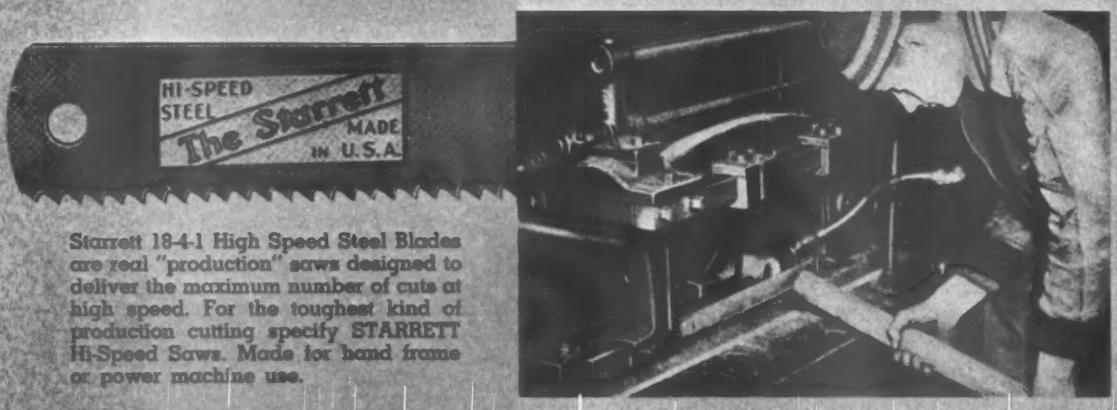
Committees have already been set up in several chapters and are being formed as rapidly as possible in the other industrial areas where A.S.T.E. chapters are located.

WHICH IS YOUR METAL CUTTING JOB?

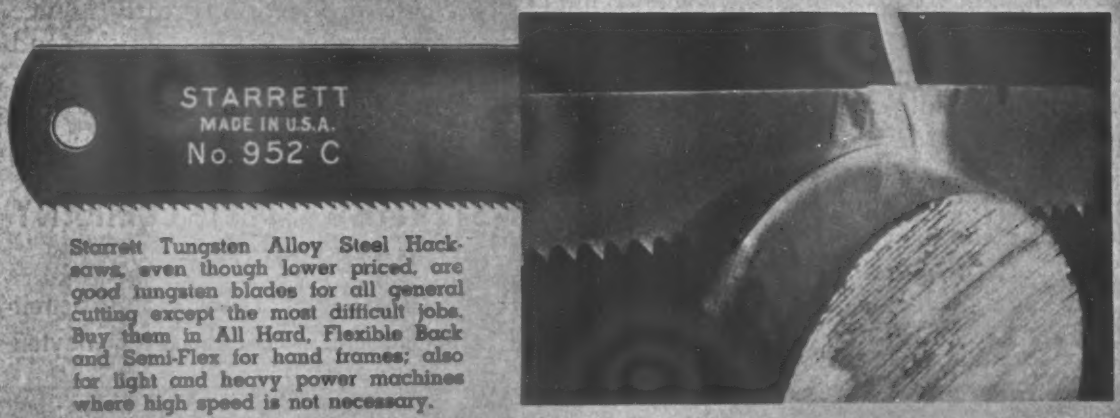
For best results, pick the one best hacksaw blade for every job from the complete line of Starrett Hacksaws



Starrett S-M Molybdenum Special Alloy High Speed Steel Hacksaws are the result of heat treating methods developed by Starrett. They are tough, fast cutting, *low cost* blades for cutting hard alloys or other metals hard to cut with other blades. Available in hand and power blade sizes. Try a box today.



Starrett 18-4-1 High Speed Steel Blades are real "production" saws designed to deliver the maximum number of cuts at high speed. For the toughest kind of production cutting specify STARRETT Hi-Speed Saws. Made for hand frame or power machine use.



Starrett Tungsten Alloy Steel Hacksaws, even though lower priced, are good tungsten blades for all general cutting except the most difficult jobs. Buy them in All Hard, Flexible Back and Semi-Flex for hand frames; also for light and heavy power machines where high speed is not necessary.

For complete information that will enable you to pick the one best blade for every job, write for Starrett Hacksaw Book "T"

THE L. S. STARRETT CO., ATHOL, MASSACHUSETTS, U. S. A.

· AVAILABLE THROUGH ALL LEADING SUPPLY HOUSES ·

STARRETT HACKSAWS

It takes a thousand skilful fingers...

to make FIRTHITE *Cutting Tools!*

The inherent ability of FIRTHITE to cut harder, tougher metals and compositions *faster, better* and *cheaper* results not only from the nearly diamond-hard qualities of the Sintered Carbides but also from the high degree of manual dexterity developed by the skilled craftsmen at Firth-Sterling. Working with precision mechanical equipment, in a modern "powdered metallurgy" plant, these experts combine latest production methods with "guild" perfection to turn out the most efficient cutting tools available today. Applied to your difficult cutting problems they often double or treble production, greatly reduce shut-downs for regrinds, improve finishes and sustain accuracies heretofore believed impossible. Write for information and new low prices today!

FIRTH-STERLING STEEL COMPANY
McKEESPORT, PA.

New York	Chicago	Cleveland	Detroit
Hartford	Philadelphia	Los Angeles	Dayton

FIRTHITE SINTERED CARBIDE **TOOLS**

IT'S NEW

Brief Reports on the very latest developments—New Equipment, materials, and processes.

Riehle Testing Machine (68)

A hundred ton materials testing machine, so powerful that it can bend two parallel 12-inch steel I-beams, yet so accurately controlled that it can crack a nut without crushing the kernel, has been built by the Riehle Testing Machine Division, American Machine and Metals, Inc.

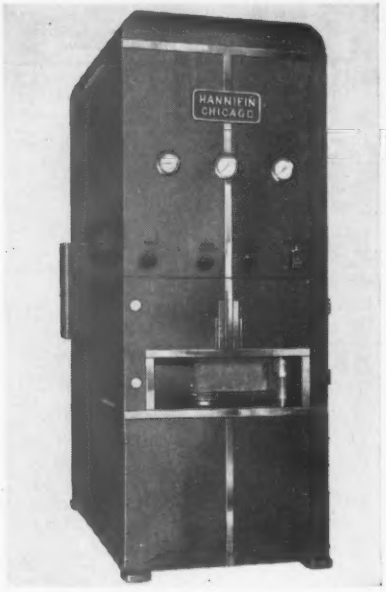
An idea of the size of the machine (see cut) is given by the figures of the men standing on the transverse table. Although it can exert a maximum of 700,000 pounds pressure, the mechanism has recorded a maximum error of .06 of one percent, making it one of the most sensitive machines of this type ever built. The machine will be used for routine testing and as a primary standard for the verification of calibrating instruments.

Carbide Tooled Cleveland Automatic (69)

A fifty percent increase in production of half inch tool steel tap blanks has been achieved through the development of an automatic screw machine installation employing cemented carbide tooling, according to the Carboloy Company. The machine, a Cleveland Automatic, is in operation at Greenfield Tap and Die. The machine is equipped with multiple tooling for turning, necking, and cutting off the blank. Carboloy tools are used for the first two operations, high speed for the cut-off. Cutting speed is 185 ft. per minute with a spindle speed of 1380 rpm and a feed of .004 in. per revolution. Material is 110 carbon tool steel.

Hannifin Centrifugal Quenching Machine (70)

A new centrifugal quenching machine



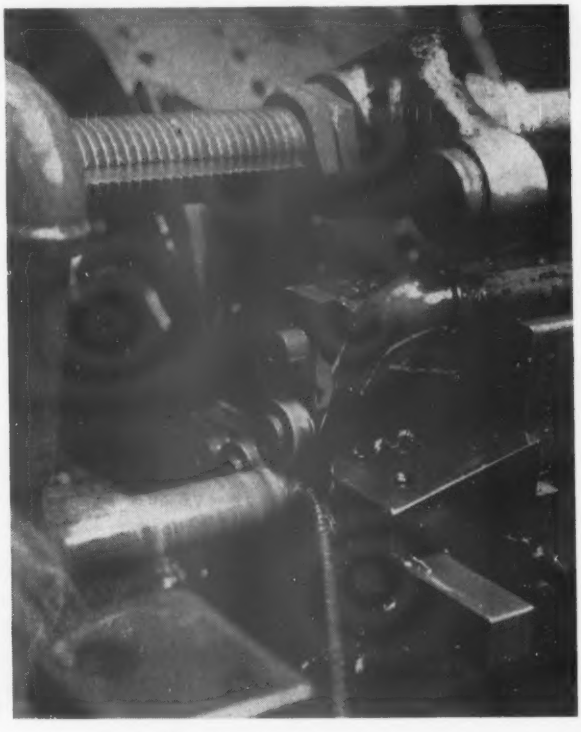
Hannifin Centrifugal Quencher
The doughnut hole prevents distortion.

is offered by the Hannifin Manufacturing Co. A major difficulty of conventional quenching methods is that in plunging circular parts into a body of cooling fluid distortion results because some portions enter the fluid more rapidly than others.

In this centrifugal quenching machine the part to be cooled is placed upon a

(Continued on following page)

Riehle Testing Machine
The I-beam cracked, but not the walnut kernel.



Carbide Tooled Cleveland Automatic
Multiple tooled for three operations.

IT'S NEW

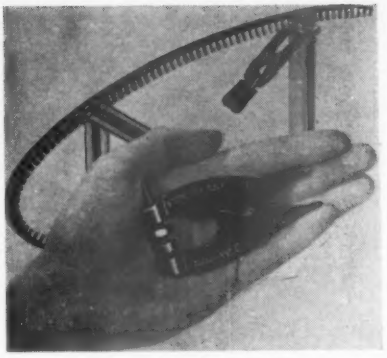
(Continued from preceding page)

holding fixture in the quenching chamber and then fixture and chamber are revolved as the quenching fluid enters the circumference of the chamber. As the amount of fluid in the chamber increases it builds up towards the center of the revolving chamber until it touches all parts of the circumference of the part to be quenched simultaneously. As this revolving doughnut gradually closes in to the center of the part it cools it uniformly and without distortion, it is claimed.

The complete cycle of automatic operation is remarkably fast, ranging from 40 to 60 seconds for representative examples of gear and sprocket quenching. The machine may also be used for sectional quenching, where desired.

Knu-Vise
Aircraft Toggle Clamp (71)

A small toggle clamp, only three inches in length, has been developed especially for use in the aircraft industry by Knu-Vise, Incorporated, 16837 Hamilton, Detroit. Despite its small size the leverage obtained by pressing the two handles between finger and thumb is in excess of ninety to one, thus enabling the operator to grip small aircraft parts with a pressure considerably greater than that obtained by the conventional clamp of small size.



Aircraft Toggle Clamp
The leverage is ninety to one.

DoAll
New Saw Container (72)

A new and improved container for saw bands is announced by DoAll Saws. It is a metal box, designed so that by holding it in one hand, the saw can be pulled out with the other in the same manner as a tape measure. Each box contains 100 feet of saw, and there is a "window" which shows how many feet of saw remain in the box.

DoAll Saw Container
It works like a tape measure.

Having the saw contained in a durable box prevents cutting hands, tangling the coil, and keeps the saw from being damaged. The box has ribbed embossing on both sides and will stand hard service in the shop.

Lipe
New Model Carbo-Lathe (73)

Designed for high production turning by the use of modern alloy tools, the Lipe Carbo-Lathe is now offered with improvements that add to the rigidity and are said to increase the ability to take heavy, precise cuts in tough materials at high

(Continued on following page)

THESE ARE YOUR "BLUEPRINTS"

to Faster Tooling Up . . . Extra Plant Capacity

Chances are you already have one or more of these Carpenter "blue-prints" for better and faster tooling-up. Now is the time to put them to work—to get more out of your present tools and equipment—to help you make the numerous and difficult new decisions you now face.

Right now everything you can do in the tool room to get tools out faster or cut down on tool-caused interruptions to production in the plant is worth more than gold. Furthermore, you may be forced to go beyond the beaten path, beyond experience to find new tooling methods, new tools, and new steels to make those tools.

Literally thousands of tool makers are meeting these new problems with the aid of Carpenter's Matched Set Method of Tool Steel Selection and Carpenter's Matched Tool Steels. To guide them they have the literature shown—which you also have (or can easily get at the cost of a penny post card). So if you tucked any of this literature away in the past—against a more urgent future need—bring it out now and look it over again.

You will be surprised at how closely it embraces your vital needs of today—how sharply it charts a plan you can use to achieve faster tooling-up—and get more from present production set-ups. Tonight take some of this material home for leisure reading. You will be amply repaid.

Carpenter
MATCHED
TOOL STEELS

THE CARPENTER STEEL COMPANY . . . . . READING, PA.

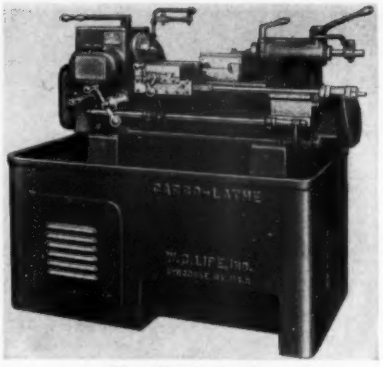
IT'S NEW

(Continued from preceding page)

speeds without chatter or tool breakage.

The base is a box section which completely encloses the motor and drive mechanism. All controls are out of sight—the motor cabinet is larger and provides for free air circulation and a motor up to ten horsepower A. C. The base also houses a coolant tank now double in capacity, and a large size chip pan.

Size of the lathe permits 12″ swing and 18″ between centers. Power is applied from the motor through worm drive. Reduction of friction is obtained by mounting the spindle on two Timken bearings, and by using ball bearings on the clutch pulley, clutch shaft, worm shaft, feed worm-gear shaft, clutch-feed shaft, hand-feed shaft, rack pinions and feed shaft in bed.



Lipe Carbo-Lathe
Designed especially for high speeds.

Chicago DeLuxe Handee Engraving Set (74)

The New DeLuxe Handee equipped with especially designed accessories is said to write on steel or glass almost as fast as one can write on paper with a pencil. Offered by the Chicago wheel and Manufacturing Company, it weighs only twelve ounces and can be plugged into any light socket. It can be used for indelibly marking and re-marking hardened steel, glass bottles, lead coated stock, painted surfaces. The unit is shaped to fit the hand with all moving parts, except the accessory being used, completely covered for accurate and precise work.

Handee Engraving Set
Writes like a pencil.

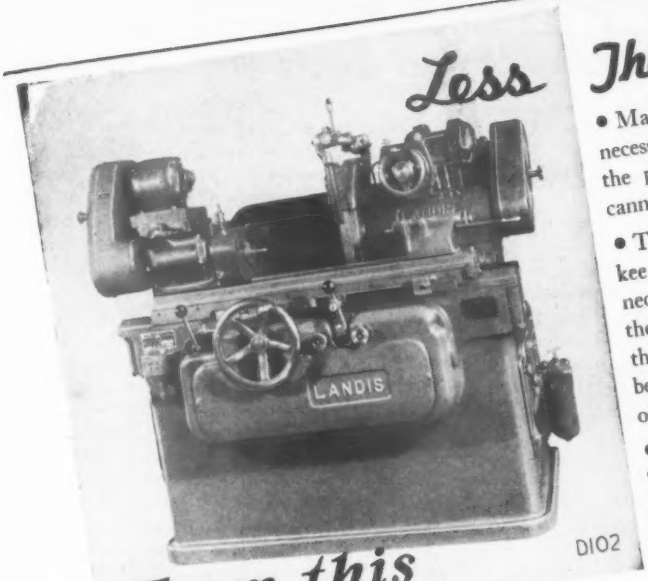
Atlas New Milling Machine (75)

Designed for improved efficiency, versatility, and economy on small piece milling, it is said, is the new Atlas bench milling machine of the Atlas Press Company, 1114 N. Pitcher St., Kalamazoo, Michigan. This new miller handles the full range of milling operations from heavy slabbing and facing to light end milling, keyways, finishing and layout work. Three types of table controls are available: standard screw feed, rapid production lever feed, and the new "Changeomatic" for instant selection of automatic table feeds.

WANT TO KNOW MORE?

For further information on any items in this department use the post card bound in this issue, filling in the key numbers which appear at the head of the items in which you are interested.

Less Than 30 Minutes



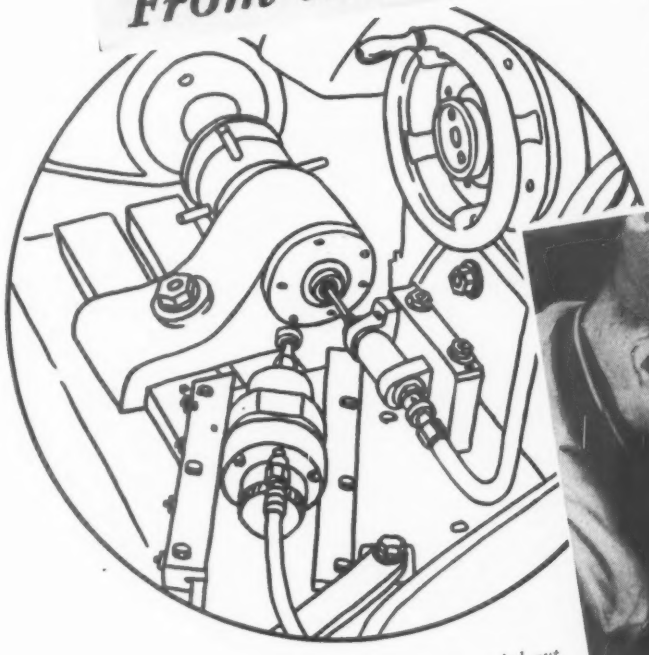
From this

• Manufacturing plants are often faced with the necessity of grinding certain odd pieces of work, yet the purchase of a new grinding machine to do it cannot be justified.

• The Delta Manufacturing Company of Milwaukee, Wisconsin, had such a problem. They found it necessary to purchase a machine to internal grind the bores and chamfers of very small spindles. But the quantities involved meant that the machine could be kept busy on this particular operation only a part of the time.

• Then they consulted Landis engineers. A 6" x 30" Type C Plain Hydraulic Grinder was recommended. It was purchased and arranged in such a manner that a special bracket carrying two air operated internal fixtures could be quickly mounted for the grinding of the bores and the chamfers. When placed in operation it was discovered that the machine was needed for these operations only one-tenth of the time and that less than one-half hour was required to make the set-up. During the remaining nine-tenths of the time the machine is used for numerous conventional between center operations.

No. 343



• The operations shown above are carried out within the very close limits of +.0003" —.000". Exceedingly small wheels must be employed yet the production is fourteen to sixteen pieces per hour.

• The results being secured by Delta suggest that many manufacturers might be confronted with a roughly similar problem. If so, why not see what Landis engineers can do about it?

PRECISION LANDIS GRINDERS

LANDIS
WAYNESBORO

Production Perspectives

News of Mass Manufacturing Everywhere

WARNING that the present spurt in business activity is not to be taken for the beginning of a period of self-sustained prosperity, the Cleveland Trust Co. advises preparation for the inevitable letdown to follow. While this expansion includes durable and consumers' goods, heavy and light industries, it does not result from free enterprise competing for business in open markets, the bank says, and does not represent genuine prosperity. "It comes instead from a situation in which two great customers, the United States and Great Britain, are demanding huge volumes of special goods and paying what they must to get them in the shortest possible time," the bank states.

The physical volume of production again increased in October and per capita national income continued the uptrend begun in April. The average income per capita is now at the highest level reached in the past decade, with the exception of June, 1936, when the soldiers' bonus was paid. Estimated per capita income in 1940 will reach 84 per cent of the 1929 peak.

Current construction of machine tools is double that of a year ago, the National Machine Tool Builders Association has reported. Productive capacity of the industry, already increased 50 per cent in a year, is still expanding. The association announced members' October operations averaged 96.8 per cent of capacity, up 1.9 from September. Capacity, measured in terms of pay roll hours, was 50.3 per cent above September, 1939. "The industry is meeting the country's defense needs by increased operating schedules and by extensive plant operations," F. V. Geier, association president said.

PERSISTENT reports assert that the main assembly plants for the automobile industry's newest undertaking—$500,000,000 worth of sub-assemblies for Army bombing planes—will be built in the Detroit area. When Defense Commission Production Chief W. S. Knudsen first outlined the program to auto leaders he said the planes would be assembled in California aircraft plants. Automobile assembly lines are already working on a billion dollar assignment for defense. If the industry takes over the assembly job also, it is estimated it would have a $2,000,000,000 job. Plan of the Defense Commission, as reported from Detroit, is to utilize all the facilities of the industry for the production of parts for the planes. Ford, Chrysler and General Motors would produce engine parts and the three body plants, Fisher, Murray and Briggs, would build the fuselages. Financing and operating details of the plans have not yet been worked out, it is understood.

A machine tool priority committee to co-ordinate national defense and commercial and export demands on the machine tool industry, was established Nov. 12 by the Defense Commission's priorities board in Washington. It will formulate policies governing operation of the voluntary preference rating system, now in effect, as it applies to machine tool contracts. Mason Britton, asistant director of the commission's machine tools and heavy ordnance division, was named a member and administrative officer of the committee. Other members were announced as follows: Clayton R. Burt, president, the Pratt & Whitney division, Niles-Bement Pond Co. and chairman of the machine tool builders defense com-

(Continued on following page)

DETROIT BROACHES

Play An Important Role In The Defense Of AIR, LAND and SEA

IN MANY PLANTS where armament work is in progress, Detroit Broaches are—and will be—doing their share to speed up the national defense program. The illustrations below show typical "broaches for defense" being produced in the Detroit Broach Company plant.

★

Detroit Broaches are used in the manufacture of many types of aircraft parts. At the right is shown a broach used in the production of propeller hubs. In the broaching operation, extreme accuracy and a high finish—free from any trace of scratching or imperfections—are definite requirements. With the entire facilities of the Detroit Broach plant devoted only to the manufacture of broaches and broaching fixtures, this company is in the best possible position to meet the most rigid government specifications.

Shown at the left is a broach used in the manufacture of various components of small arms. This type of work requires a high degree of accuracy in exceptionally high production—in which combination Detroit Broaches have proved very successful. On many such jobs, which formerly were profile-milled, Detroit Broaches are now used. There are no limitations to the contours which can be broached by Detroit Broaches.

A great deal of publicity has been given to the new torpedo or "mosquito" boats now being used by the Navy. The broach at the right will be used in the production of the engines for these modern craft. This is one more instance where accuracy and a high finish is demanded for vital parts.

★

Whether you are engaged in armament work or regular production, Detroit Broaches can be instrumental in increasing your production and lowering your costs. A consultation with one of our Engineering Staff will obligate you in no way.

DETROIT BROACH COMPANY

6000 Beniteau Avenue • • Detroit, Michigan

PRODUCTION PERSPECTIVES

(Continued from preceding page)

mittee; Frederick Geier, president, Cincinnati Milling Machine Co., Lieut. Col. A. B. Johnson, representing the army, and Commander E. R. Henning, representing the navy.

LABOR shortages in Western Massachusetts, confined in recent months to the highly skilled labor groups, have now become acute in the production lines, officials of the Massachusetts State Employment service disclose. Describing the lack of certain production workers as now approximating that of World War time, George F. Harding, manager of the employment service, issued an urgent call for punch-press operators. So acute has the shortage become, Harding said, that it has now spread even to rough grinders. For the first time in years, the state employment service will begin to advertise in the classified sections of newspapers, Harding said, and also will use some newspaper display advertising in attempting to line up the needed help.

The Springfield Armory is now running ahead of its official production schedule and has reached its present goal of 500 Garand rifles daily three weeks ahead of schedule, Brig.-Gen. Gilbert H. Stewart, commanding officer, discloses. When the new $500,000 factory building is completed and ready for use, the production goal will be set at 1,000 daily. Two years ago, the Armory was turning out only 40 Garands a day. Present employment at the Armory, the general said, is slightly more than 4,200.

The Greenfield Tap and Die Corporation's plant No. 2 is soon to be enlarged by the addition of approximately 40,000 square feet of floor space, President Howard Hubbard announces. Construction of a new two-story brick and steel building will be undertaken soon, President Hubbard said. The new building will be put up in compliance with a government request that the corporation's gauge department be expanded substantially. This would mean the employment of several hundred additional men.

THE government has awarded national defense contracts totaling well over $5,000,000 within the past four months to industrial concerns in the Springfield area, George A. Mohlman, industrial division chairman of the Springfield Committee for Emergency Preparedness reports. The orders, according to Mr. Mohlman, who is vice-president of Package Machinery Co., of Springfield, call for motorcycles fire control instruments, sighting systems, telescope and rifle parts, compressors, gauges, heating equipment, and engine parts. These contracts were awarded from June through September, and more orders are expected shortly, he said. At the same time, Mr. Mohlman announced that his company, in line with its policy of aiding national defense in any way possible, has just taken over a substantial amount of work for Van Norman Machine Tool Company which is now operating at capacity on defense tool orders. "Machine tools are of vital importance at this moment, and we are glad to place these orders, before other work to help defense production get into full swing," Mr. Mohlman said.

A total of 8,279 workers has been added to the pay rolls of 100 representative Cleveland industrial companies in the last four months, a monthly employment survey showed Nov. 6. This figure, which includes the addition of 3,119 workers to factory pay rolls in October, represents an increase of more than 11 per cent since the end of last June. With 62 of the 100 concerns reporting employment gains in October, industrial employment has reached a new peak of 82,221, the highest recorded by the participating companies since May, 1937, when the plants reported 82,634 employes. The October increase represented a net gain of nearly 4 per cent and marked the fourth consecutive month of job increases in Cleveland industry. It also reflected a 15 per cent rise over October, 1939.

A TOOL ENGINEER SYMPOSIUM

GEAR FINISHING

I. SHAVING AND LAPPING GEARS

by **CHARLES R. STAUB**
Chief Engineer, Michigan Tool Company
and **MARVIN R. ANDERSON**
Vice President, Michigan Tool Company

BEFORE the advent of crossed axis shaving it had been the practice to finish cut teeth on gear blanks by a tooth generating operation wherein the cutter or hob and the gear blank are rotated in timed relation to each other.

The gradual development of such generating machines and tools had materially reduced characteristic errors in tooth profile and spacing. Nevertheless, owing to variations in materials and grain structure in the gear blanks, and also because of inherent machine errors such as accumulated errors in gear trains, lead screws, bearings, and improper mounting of generating tools, the spacing and profile of the gear teeth were not entirely uniform with the result that gears were still not sufficiently quiet. The discovery and development of crossed axis shaving solved the problem.

The cause of noisy gears is an accumulation of errors in contour, spacing, and eccentricity, measured generally in ten thousandths of an inch. The elimination of these errors not only produces quiet running gears but increases their life in service.

There are cases on record of thousands of gears that have been hobbed or shaped to finished size, and then rejected at final inspection because they were beyond permissible tolerances for smoothness of roll. These same gears were then shaved on a gear finishing rack without changing their size anymore than .0005" on P.D. and were better gears than the regular run, because by this method conjugate tooth forms had been produced and a much smoother finish obtained.

Principle of Operation

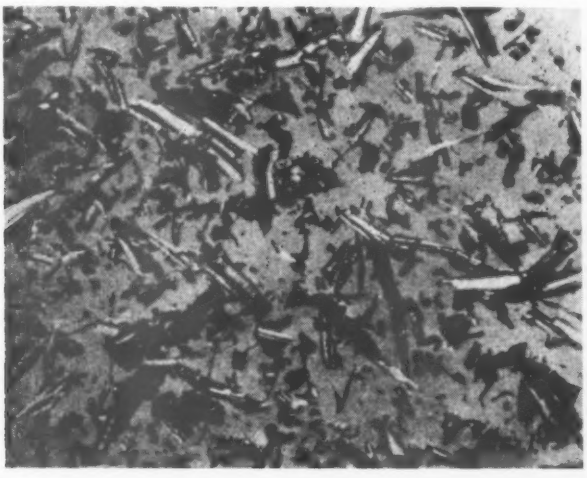
In crossed-axis shaving gear teeth are finished by rolling the gear relative to a rack or rotary cutter while the gear and cutter or rack are moved laterally relative to each other with their axes askew.

Shaving is a method of removing metal from the contours of the gear teeth by cutting, and is not a cold working process. The metal cuttings removed by this method, when examined under a glass, are found to be minute curled chips *(Figure No. 1)*.

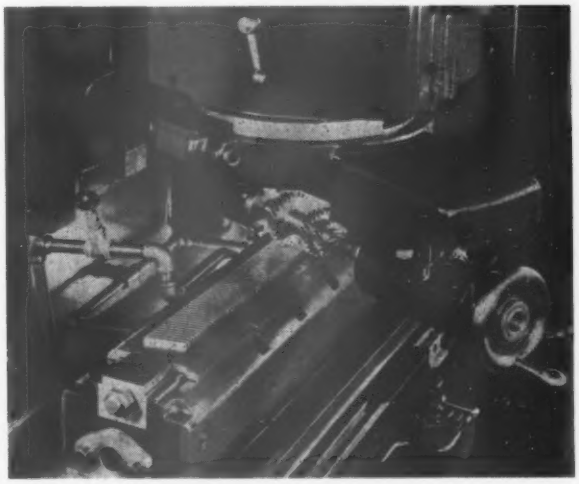
Either the Rack or Rotary method produces extremely accurate gear teeth, principally because of the accuracy that can be built into the finishing tools. Furthermore, with the work on live centers, and no indexing mechanism—with the tools themselves driving the work—machine errors and their influence on gear accuracy have been practically eliminated.

For best results, accuracy of gear blanks and the condition of material are determining factors. The material should be held beween 25 and 30 Rockwell "C" scale, and very close attention should be paid to the quality of the gear blanks, including hole size and face runout. The face runout should

Fig. 1. Metal Cuttings Produced by Shaving.



Rack Type of Gear Finisher. Fig. 2.



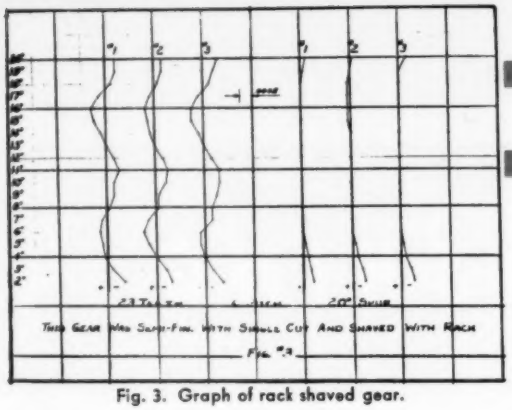


Fig. 3. Graph of rack shaved gear.

Shaving and

The development of crossed axis shaving has increased uniformity and diminished noise of gears.

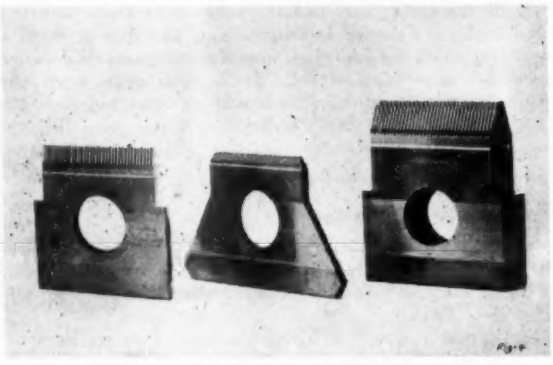


Fig. 4. General design of rack blade.

not exceed .001" on gears from 2½" diameter up to 8" and gears smaller than 2½" and with small holes should be held within a few ten thousandths.

The process is suitable for shaving helical and spur external gears, and spur and helical internal gears. With it, particularly as applied to the rack type of machine, it has become possible to rapidly finish gear teeth to a higher degree of accuracy than has ever been possible before.

Such good results have been obtained by shaving, in industry, that most Engineering Departments are paying closer attention to design so that all gears will lend themselves more readily to the shaving operation.

Rack Shaving

As mentioned, there are two methods of finishing, rack and rotary. In the rack type of gear finisher *(Figure 2)* the working surfaces of the teeth of the basic generating rack are provided with a plurality of narrow parallel grooves separated by narrow lands, the edges of these lands forming parallel cutting edges. These cutting edges are vertical in the normal section of the rack.

The rack is mounted on the table of the machine and reciprocates similarly to a planer table. The gear to be finished is mounted on live centers, in the head of the machine. The head is swiveled so that the axis of the gear is set at an angle with the rack equal to its helix angle. (Unless the helix angle exceeds 30° to 33°). Straight type racks can be used for finishing both right and left hand Helical gears up to 30° Helix Angle. With greater Helix angles an angular rack must be used, either right or left hand as required. With the rack blades set straight across, and since the rack travels in a plane at an angle to the axis of the gear, the result is a constant shaving action between the cutting edges of the rack teeth and the gear teeth being finished.

In *Figure 3* is shown a graph chart of a six Pitch 20° Pressure Angle gear that was semi-finish hobbed one cut and then shaved on the rack type shaving machine. The left side of the chart shows the check on contour of the rough cut gear and the right side of the chart shows the same gear after it had been shaved.

The gears produced are concentric, uniformly spaced, and have an accurate profile. Moreover every gear will be exactly the same size on pitch diameter. Normal or base pitch will always be correct since the basic rack cannot finish gears otherwise.

This is largely responsible for the fact that rack shaved gears are consistently quiet. Another contributing reason is that the gear being shaved with a rack is in area contact with the shaving tool thus affording better control.

Figure 4 shows the general design of a rack blade. The

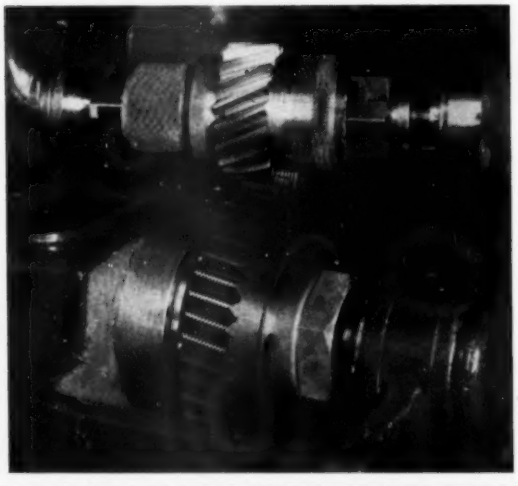


Fig. 5.
Rotary Shaving

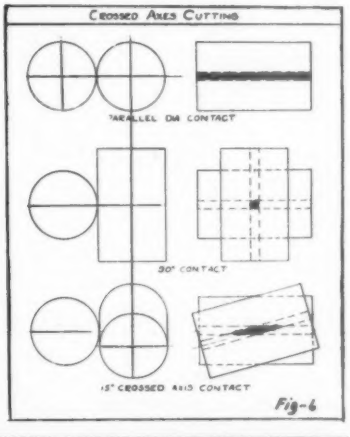


Fig. 6.
Effect of
Angular Positioning

Lapping Gears

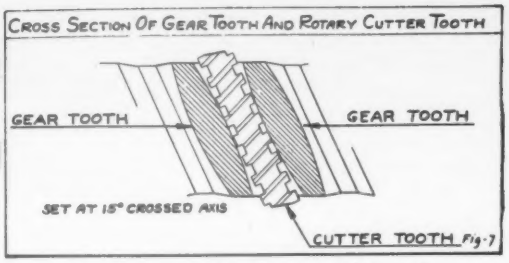


Fig. 7. Gear tooth and cutter tooth in mesh.

An important advantage of shaving is economy: tool cost per gear is only a half cent with rack method.

thickness of the blade equals the circular pitch of the gear. All blades are hand lapped to exact size for thickness and parallelism. Blades may be sharpened a number of times during the life of the rack. More than 1,000,000 gears have been finished with a single rack.

Another advantage in shaving is its economy. The tool cost per gear when shaving by the rack method is less than a half cent. Machine operators do not have to be experienced as the machines are very simple to set up and operate. If it is necessary to reduce sizes on pitch diameter one thousandth or more for backlash, the gears can be recut in less than a minute's time without scrap, something impossible by any other method.

The shaving process is used almost 100% in the automotive field and very extensively on turbine and reduction units, and the time is not very far distant, in our opinion, when aircraft gears will be shaved. Grinding gear teeth is a very expensive operation which can be avoided, however by changes in design of aircraft gears to reduce distortion in hardening. A good point to bring out here is that gears for aircraft are not ground to obtain quietness of operation but to obtain accuracy. However, accurate gears are invariably quiet. The fact is that a heat treated gear of about 38 to 40 Rockwell "C" scale, and accurately finished will outwear a hardened inaccurate gear.

The importance of paying close attention to gear steels and their treatment cannot be stressed too greatly. The trouble in the past has been that too many people have been of the opinion that high quality in gears is dependent almost entirely on the equipment and personnel of a gear department. We will grant that this is true to a great extent but the task of making good gears can be made a lot easier if strict attention is paid to the processing of the gear steels. By that, I mean, every heat of steel should be tested for its physical properties and grain size. Forging heats should be held, and forging dies kept in good condition so that the flow of metal is uniform. Normalizing heats should be held within the proper range, and last but not least gears should be hardened and quenched at the proper temperatures.

Rotary Shaving

In the rotary method of shaving, the rotary shaving cutter is a gear-like tool having a plurality of teeth conjugate to the teeth to be produced on the gear to be finished. The working surfaces of each of the teeth of this tool are provided with a plurality of narrow parallel grooves separated by narrow lands, the edges of these lands forming parallel cutting edges. These cutting edges extend vertically from the roots of the teeth to their crest. *(Figure 5)*

Developed principally for job lot gear production, rotary shaving is also useful in finishing gears that have too much interference to be finished by the rack method, as in the case of closely designed cluster gears.

The circular type of shaving tool is restricted to a smaller shear angle than the rack. This is due to the fact that when a spur gear is in mesh with a helical gear, or a pair of helical gears are brought into mesh with their axes crossed at an angle, the contact area between them is greatly reduced, due to the angular positioning and relative curvature of the two surfaces in contact. The effect of this characteristic for different angles is shown in *Figure 6.*

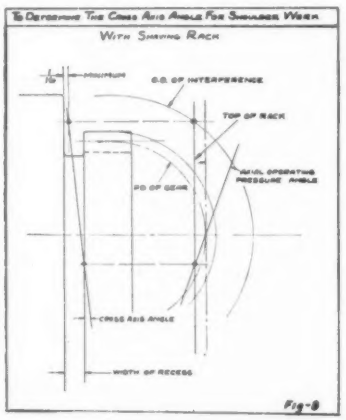


Fig. 8.
Method of determining cross axis angle with rack method.

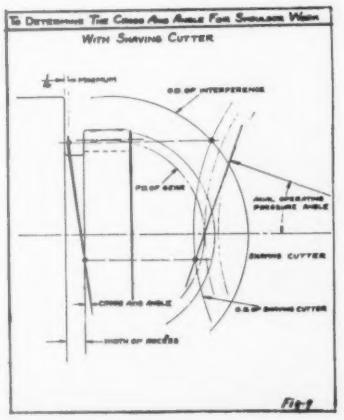


Fig. 9.
Method of determining cross axis angle with rotary cutter.

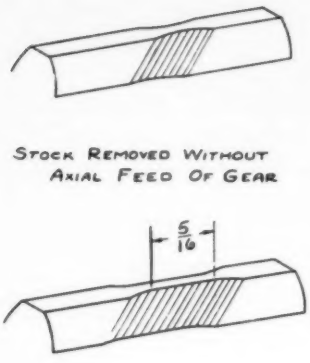


Fig. 10. Effect of axial feed.

Shaving and

Lapping is a refining process for giving gear teeth a smooth finish rather than a cure for every ill.

At the top is shown the contact between two cylinders or two spur gears on parallel shafts. The center sketch illustrates the contact between the same two cylinders with shafts at right angles, while the lower sketch shows the cylinder set at a shaft angle of 15°. A similar contact exists when a spur type cutter is meshed with a helical gear.

Figure 7 shows a cross section of a gear tooth and a cutter tooth in mesh with their axes crossed at an angle. This section is taken in a plane tangent to their pitch diameters.

The angular setting of tool and work axes of course have a distinct bearing on the cutting action of the tool and the finish that can be obtained. The greater the relative angularity of the axes, the greater the cutting efficiency. If carried too far, however, there is danger of losing control of the product, thereby affecting quality, due to the fact that the contact area has been reduced to the danger point, as has been illustrated in *Figure 6*.

The most efficient shear angle range is from 12° to 15°, but where clearance is limited shear angles as low as 3° have been used. Even with so small an angle, gear quality is still superior to that obtained by finishing with either the hobbing or shaping process.

Figure 8 shows the method of procedure to determine the crossed axes angle for shoulder work when gears are to be shaved by the rack method.

Figure 9 shows the method used to determine the crossed axes angle for shoulder work when shaving by the rotary cutter process.

The effect of axial feed of the gear during rotary shaving is illustrated in *Figure 10*. The upper sketch shows stock removed without axial feed of gear. The lower sketch shows the same gear tooth when an axial feed has been employed to the extent of 5/16" axial travel.

Figure 11 shows how the crossed axis pivot point of the cutter should be placed in relation to the gears being finished on both plain gears and gears having interference. This pivot point must pass beyond both faces of the gear in order to properly finish the teeth to the full width of the gear.

Spur type shaving tools can be used for finishing both right and left hand helical gears up to 15° helix angle. With greater helix angles, right and left hand helical shaving tools must be used.

Requisites for Shaving

In shaving gears by either the rack or rotary method, it

Fig. 11. Placement of pivot point.

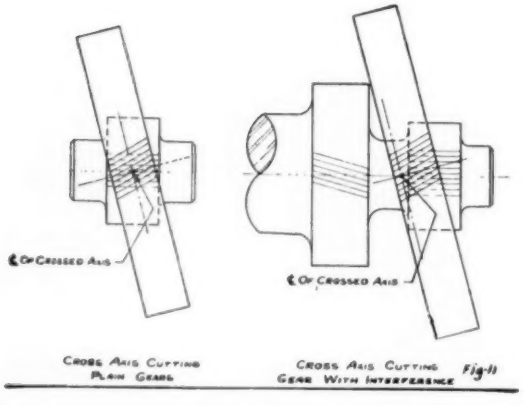
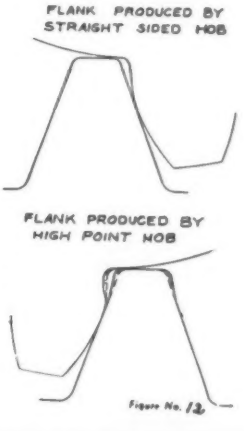


Fig. 12. Use of protuberance.



Lapping Gears

Long lapping cycles should be avoided: the cause of excessive errors should be sought instead.

is necessary to semi-finish hob the gears deeper than standard depth in order to avoid interference between the tips of the rack blades or the rotary cutter teeth with the fillet at the base of the gear tooth. This depth is usually figured $\frac{2.35}{\text{N.D.P.}}$. It is sometimes necessary to use a hob having a protuberance at the tip *(Figure 12)* in order to avoid interference. The total depth of cut however is calculated in the same manner.

It is very important in designing gears to be sure that they have sufficient involute overlap or teeth in contact as well as Helical overlap. It is equally important when shaving gears by either method to be sure that there is sufficient overlap for carry-over in order to have continuous action. There seldom is any difficulty with this except in the case of involute spline shafts or gears of small diameter or short stub teeth.

Figure 13 shows a method of figuring the number of teeth in contact for external gears.

Figure 14 shows a method of figuring the teeth in contact or involute overlap with an internal gear and pinion.

One of the requisites for high quality in shaving is to have the semi-finished gears come to the shaving operation with a uniform amount of stock. It is standard practice, when semi-finishing gears to be shaved, to hold the amount of stock within .008 to .010 inches (micrometer reading measured over pins) over and above the finished size of the gear.

We might point out here that in semi-finishing gears to be shaved, ground-form hobs of Class "B" tolerance can be used and the hobbing operations speeded up over and above that when gears were finish hobbed. Inasmuch as Class "A" hobs are used when finishing by hobbing, there results a considerable saving both in cycle time and tool cost.

Gear Lapping

So long as gears have to be hardened there will always be a certain amount of distortion. Engineering and metallurgy have not as yet reached the stage of perfection, although great strides have been made in reducing the amount of movement in steel when hardening.

Therefore, it was found necessary to devise some means by which such errors can be corrected. The result was the development of the modern Gear Lapping Machine. Some people are still of the opinion that Lapping is a cure-all for every gear ill, which is a misconception of the process. Lapping is intended primarily as a refining process. It will only correct errors of reasonable proportion in tooth profile, spacing and lead. It will give the gear teeth a smooth finish thereby improving the sound of the gears when assembled and running.

It is also standard practice to lap ground gears. By so doing the small ridges left by the grinding wheel are smoothed out, giving the gears a more mellow tone.

Before the advent of the modern gear lapping machine, the method used was to lap gears together in pairs—in reality only a running-in process—and the gears had to be kept in pairs.

There are different types of gear lappers in use today, the single spindle and the multiple spindle types. The multiple spindle is the more effective and efficient of the two because it affords better all around control.

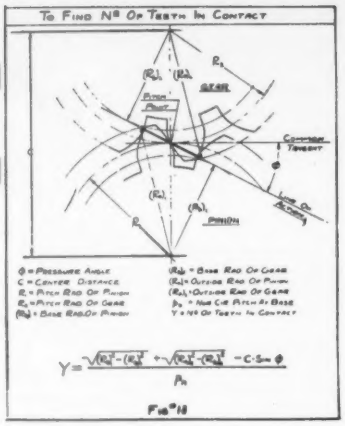


Fig. 13. External Gear Computation

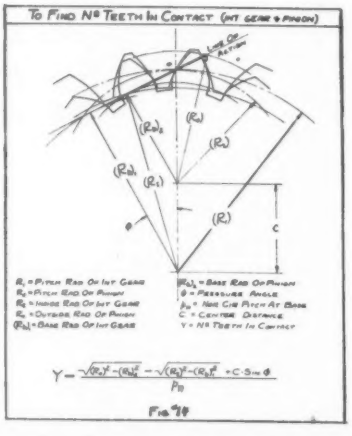


Fig. 14. Internal Gear and Pinion Computation

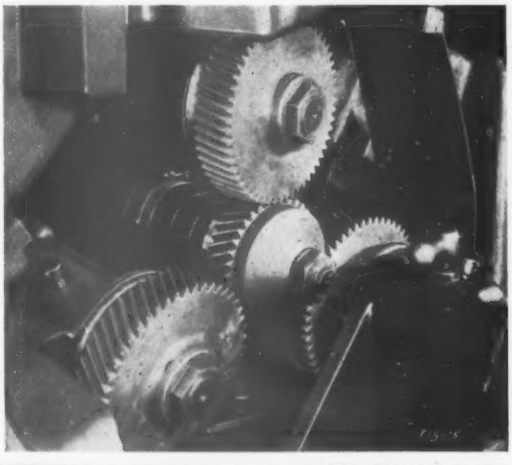


Fig. 15. Three-Spindle Lapping Machine

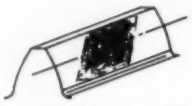


FIG. 16 SHOWS THE CONTACT OF A 5° R.H. LAP WITH A SPUR GEAR TOOTH

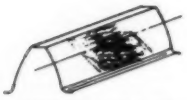


FIG. 17 SHOWS THE CONTACT OF A 5° L.H. LAP WITH A SPUR GEAR TOOTH

Figs. 16 and 17.

FIG. 18
DESIRABLE BEARING

FIG. 19
CORNER BEARING

FIG. 20
CROWN OR CENTER BEARING

FIG. 21
HIGH BEARING

FIG. 22
LOW BEARING

Figs. 18, 19, 20, 21, and 22.

Figure 15 shows a close-up of the three spindle types with three laps in mesh with the gear being lapped.

The gear being lapped is mounted between centers and is the driving member, driving the three laps. Each lap spindle is equipped with a brake that can be set for any desired amount of pressure. In the three lap method, one lap is made to run at parallel axes with the gear being lapped, the second lap is set 3° to 5° out of parallel right hand, and the third lap is set 3° to 5° out of parallel left hand. The resultant crossed axes with the gear provides effective lapping on the pitch line, as well as above and below. The brake pressure should be set at not more than 75 to 100 pounds for best results.

One of the requisites for efficient lapping is a fast reciprocating motion with a slow peripheral speed of the gear being lapped.

Figure 16 shows the contact of a 5° right hand lap with a gear tooth. *Figure 17* shows the contact of a 5° left hand lap with a gear tooth. The effectiveness of the crossed axis principle can readily be seen.

The reason for better control by the multiple spindle method is that the laps prevent the gear being lapped from accelerating or decelerating with the various errors in the gear. For instance, if one lap is in mesh with the gear where there are "plus" errors, while one of the other laps is in mesh where the errors are "minus" or zero, the pressure will be greater at these points of error and will cause faster lapping action instead of allowing the gear to follow through without any resistance.

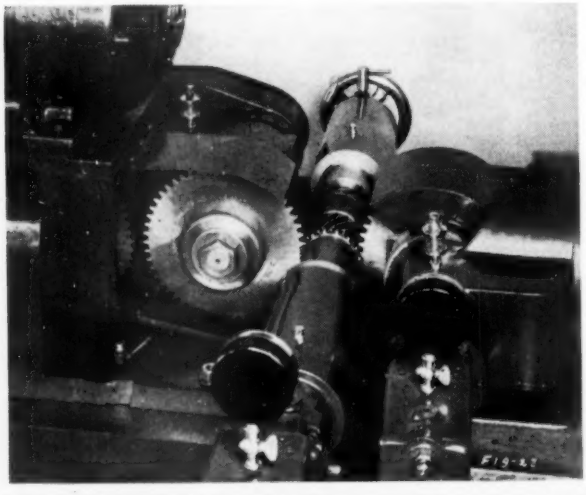
Another decided advantage of the multiple lapping method is the ease with which a gear can be crowned. This is accomplished by setting one lap off angle in one direction and another lap off angle in the opposite direction, thus lapping across the corners of the gear teeth.

It is better to crown by this method than to crown gear teeth by the shaving method before the gear is hardened because since this is the final operation the results are permanent. Furthermore, the process is much cheaper.

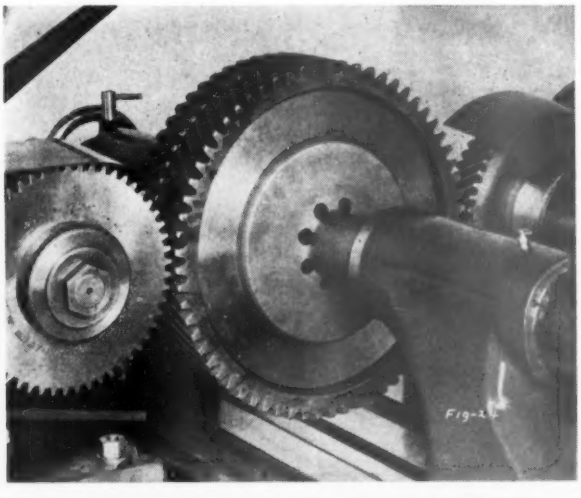
Time required to lap the average run of gears is from one-half minute to two minutes per side of gear teeth. If it takes much longer than this it is an indication that the gears are not coming to this operation within reasonable tolerances and an investigation should be started to determine the cause of excessive errors instead of trying to eliminate all of the trouble by lapping. In trying to correct excessive errors by lapping through long cycles, the chances are that the gears will become worse instead of better due to excessive wear on the laps, since laps will eventually wear to the average error in the gear being lapped.

Another good point to bring out here is that the use of too much lapping compound is as detrimental as lapping through too long a cycle. It is better to brush the compound

Fig. 23. Close-up of lap heads.



Lapping a large Herringbone gear. Fig. 24.



on rather than flow it on with a pump. When the laps become worn, lap teeth can be turned off and a different number of teeth cut in the same blank, thus keeping lap cost to a minimum.

Gears of coarse pitches and of larger diameters can be lapped as long as twenty minutes per side of gear teeth without fear of spoiling them, providing good judgment is used as to the amount of pressure applied and the amount of compound used.

In *Figures 18-22* inclusive are shown desirable bearings and also erroneous bearings that sometimes appear on gear teeth and how to correct them.

The bearings desired between the teeth of two mating gears as was shown in *Figure 18* consists of a full bearing on the face of the tooth.

When teeth are not parallel to the axis of the gear (as in spur gears) and when the Helix angle is not correct (on Helical gears), the type of bearing shown in *Figure 19* is produced. This is also sometimes caused by heat distortion. Unless distortion is excessive such bearings may be straightened by lapping.

The type of bearing shown in *Figure 19* is sometimes also produced under heavy torque loads as a result of shaft deflection, on gears which under light loads would present a normal bearing. Where such misalignment may occur, or where there is a chance that shafts will not be perfectly parallel, the type of bearing shown in *Figure 20* presents definite advantages. Heavy at the center, and fading out toward the ends of the teeth, the bearing will insure quietness under such conditions. It may be obtained by setting one lap "plus" on a 3-lap Lapper, and one "minus", leaving the third lap on the correct setting. Adjustable lap spindles are required to obtain this type of bearing.

Figures 21 and 22 illustrate "high" and "low" bearings on gear teeth. To correct for a "high" bearing, two of the laps on a 3-lap machine should be withdrawn sufficiently to cause lapping action mainly toward the top of the tooth, leaving the third lap on proper center distance. On a 2-lap machine, one lap is withdrawn and the other remains on correct center distance.

The condition shown in *Figure 22*—a low bearing—may be more easily corrected by lapping the mating gear than the gear showing the low bearing. This correction should be similar to that for a "high" bearing on the mating gear, since lapping the latter toward the top will bring the bearing down the desired amount.

Figure 23 is a close-up of the lap heads which are also equipped with pressure brakes.

Figure 24 shows a close-up of a large Herringbone gear being lapped on the large machine. Both of the two-lap models are particularly suitable for this type of work. Both sides of the herringbone gears can be lapped in one cycle by having one lap in mesh with the one side and the other lap engaging the other side. Another desirable feature which is incorporated in all efficient lapping machines is that the direction of rotation is reversed at the end of each half cycle.

Since the development of the crossed axis method of finishing gears some thirteen years ago, and its application to both gear finishing and lapping, much has been learned about gear production control. As a result, it is our conviction that these processes today present the most economical and fastest methods available for obtaining—consistently—gears of high accuracy and smooth finish, for quieter operation and longer life.

II. PRODUCTION OF GEARS BY SHAVING AND LAPPING METHODS

by OTTO H. SCHAFER
President, Schafer Gear Works

TOOL ENGINEERS, Machine Designers and Gear Engineers, with their combined efforts have made possible the mass production of master gears flowing through many production lines today. Thousands of automotive gears are processed daily by shaving and lapping of teeth, and are equal in quality to master gears that can be purchased from various sources.

Many transmission gear manufacturers expected, and usually had from 25% to 45% rejections daily in their final assembly test rooms. This condition existed not more than ten years ago. Today, most of these companies enjoy an average of only half of one percent rejections.

Accuracy control of tooth profiles started in 1920, when Mr. Karl L. Herrmann, Executive Engineer of the Studebaker Corporation, Detroit, presented to industry his hob and gear tooth measuring instrument. Even today, the hob manufacturer will gladly submit, upon request, a tooth profile chart with any hob ordered. The same type of tooth profile instrument is still being successfully used.

Gradual improvement in quality of transmission gears was made from 1920, but in 1930, the general public became more conscious of gear noise. The usual errors in tooth profile, index, eccentricity, helical angle and tooth finish, all measured in tenths, were still great enough to be serious.

About this time, the rack type gear tooth shaving machine and the rotary crossed axes shaving and lapping machines were introduced to the automotive industry. Almost immediately, a great improvement in quality of transmissions was obtained. These first machines were rather light in construction and have since been made considerably more rigid, eliminating all deflection, permitting the consistent production of extremely accurate gears.

Mr. Staub has elaborated on the rack type shaving machine and I shall therefore confine my remarks to rotary crossed axes shaving and lapping.

Crossed Axes Shaving

The basic idea, behind this method of gear tooth finishing is the crossing of the axes of cutter (or lap) and work gear at a limited angle. In crossed axes shaving, the work gear is rotated under only slight pressure with a special cutter in the form of a master gashed helical gear—the work gear and the cutter having different helical angles.

The angle made by their axes in the machine setting, is equal to the difference in their helical angles. Best results are obtained when this angle is within the range of between ten and fifteen degrees. The cutter is normally mounted with its center over the intersection of the axes of the two shafts in order to assure correct tooth profile and helical angle in the gear being shaved.

The relation of the axes compensates for the variation in sliding action due to the involute roll. As the work gear and the cutter teeth are brought together, cutting continues toward the pitch line up to the center point and in the reverse direction as they pass that point and separate. Thus uniform cutting action is assured over the entire gear tooth profile. The pressure normally exerted between the gear and cutter at angles from ten to fifteen degrees is approximately forty pounds, varying somewhat according to the analysis of the steel being processed.

The cutter head has its own separate motor drive. The

table is fed and reciprocated by its own motor, which is smaller than the unit driving the head. The pressure lubrication system is driven by a third motor located at the base of the column. The original master helical cutters did not have sufficient clearance in the bottom, and difficulty in removing the chips was encountered, as the serrations would load up. This condition has been corrected by the adoption of quite a large circular shaped clearance space at the root of the teeth, permitting a rapid flow of the lubricant, which removes all of the chips. This continuous flow of lubricant is provided on both sides of the cutter contact in order to rapidly wash out all of the hair line cuttings immediately after they are formed. A relatively high oil pressure is used for this purpose. A series of strainers and baffles prevent chip return to the cutter faces.

Produces Smooth Finish

The table feed mechanism, located at the left hand end, raises the table vertically at the end of each stroke as the cutter passes out of pressure contact with the work gear. At the completion of each table cycle, the table is automatically fed from .001" to .003" upward. This removes from .002" to .006" on pin sizes. At the end of each predetermined number of cycles, the machine automatically stops for the work to be removed.

With the machine on cutting stroke, the surface produced on the work gear teeth has minute lines traveling up the tooth from the bottom to top, which indicate the spacing of the cross travel of the work per revolution. The gear is fed across the cutter at from .008" to .020" each time the work makes one revolution. Inasmuch as the cutter contacts the work at a different point on each stroke, these lines are completely removed by one or more idling strokes after the actual cutting operation is completed.

Table travel is set at an amount equal to or a little greater than the face of the gear being finished. As the table arrives at either end of its travel, the direction of rotation of the cutter arbor is likewise reversed to achieve symmetry of action.

The final result is a very smooth finish on the work gear tooth surface. Any slight variation in helix angle of the first sample gear can be corrected by revising the head setting, which is equipped with both a vernier scale and dial indicator against a button.

The work gear mounted on live centers is driven and guided by the cutter—no other connection exists between them; therefore a reproduction of the accuracy of the master cutter is transmitted to the finished work gear. The tooth profile of the gear, helix angle, spacing and concentricity are determined solely by similar functions of the master cutter itself.

Production of Gears by

Precision is built into the gear machine and only careful, not skilled, operation is required.

Cutter speeds are quite high, normally about 400 feet per minute.

The circular crossed axes shaving machine is fully automatic and requires no particular skill or judgment in its routine handling. One machine operator can readily serve a battery of these machines.

Floor to floor time is only about 15% of that required to finish a gear with a light cut on standard gear cutting machines and with results far superior to such methods. For instance, a 20 tooth gear with 9.25 pitch, 20 degrees pressure angle and 35 degrees helix angle can be completely processed in from 20 to 40 seconds (floor to floor) depending on the amount of stock removed.

The life of a master cutter is unusually high. Normally, from 6,000 to 12,000 work pieces can be processed before it is necessary to regrind the cutter. In normal pitches, a cutter may be reground a number of times. In 5 pitch cutters, seven to ten regrinds are practicable, thus making a total of 42,000 to 100,000 work pieces per life of the cutter.

Producing precision gears by the crossed axes shaving method requires precision made rigid machines, that are kept in the best of operating condition, and manned by careful operators, not necessarily skilled. The precision built into a master cutter begins in the steel mill, where forgings are carefully hammered to produce the proper grain structure. Finishing the tool requires careful engineering and handling by skilled craftsmen; yet, this tool is sometimes broken due to carelessness or inexperience.

Causes and Remedies

1. *Improper handling.* The precision master cutter obviously must be handled with care.
2. *Cutter running into shoulder of adjacent gear.* This con-

IN THIS CORNER

Michigan Tool's Staub
"It is our conviction . . ."

Schafer's Schafer
"Only 0.5% are rejected."

Shaving and Lapping Methods

"Complete control of all factors is now available — mass production of quiet gears is a reality."

dition is frequently caused by improper setting of stops controlling table feed, or the safety switches on this same table, or excessive variation in the length of parts to be shaved.

3. Chips and slugs packing into serrations. Chips clinging to the gear teeth from the previous operations, viz.; hobbing, shaper cutting and tooth rounding must be washed or brushed off to avoid falling in between the teeth of the gear and the cutter while in engagement. Since the cutter and gear operate in tight mesh, any slugs trapped between the teeth of the two members will be packed between the lands of the cutter. When the lands are broken, the efficiency of the cutter is reduced.

4. Improperly Hobbed or Shaped Gears. Cutters frequently break on gears where the hob or cutter did not pass entirely through the face width, therefore, leaving a scallop in the root diameter, and a slight increase in the chordal thickness of the gear tooth in the end of the cut. Also, when shaper cuts do not complete the entire cycle of teeth, one or more are left thick. Whenever these conditions exist, the cutter will break and be a total loss.

To guard against this type of breakage, many firms have an inspection operation, which in most cases, the shaving machine operator has time to perform.

5. Oversize Gears. Standard practice for automotive transmission gears and commercial gears of similar pitch is to allow .006" to .010" stock over pins, to permit full correction and clean up of tooth profiles. An abnormal initial cut results when gears larger than above mentioned size are shaved; gears should not be roughed out on a finish shaver.

6. Cutter running out of mesh. The stroke should be set just long enough to produce a good tooth. A longer stroke endangers the cutter by running it out of mesh, thereby increasing the shaving time and shock of reversal. This is a function of proper setting of table feed stops.

7. Loose nut on Cutter Arbor. A loose nut on the cutter arbor allows the cutter to shift on the spindle from its fixed position, therefore, making it possible to come out of mesh at one end of the stroke, and upon the return stroke, engages the cutter against the face of the gear and breaks it, or damages the teeth badly on one end.

8. Loose Nut on Gear Arbor. The out of mesh condition is also the result of a loose gear arbor nut, particularly on heavy gears, as a heavy gear driven by the cutter reverses with impact at the end of stroke and may loosen the nut if not securely tightened.

9. Operating Cutter Dry. Due to the high surface speed at which the master cutter operates, and due to the high involute sliding action on some gears, it is imperative that proper coolant and lubrication be supplied abundantly to cutting surfaces at all times. A good quality of sulphur base oil is best suited for this unique operation for best all around performance. The worst condition is where the oil supply is completely shut off even for a few seconds.

The heat created by running a cutter and gear dry is high enough in a short space of time to gall the profile of the cutter teeth to such a degree that resharpening becomes necessary. The oil pump and oil lines must be clear and free of all sludge and chips. The oil reservoir should be cleaned at least once a week on heavy production machines, and twice a month on average machines operated only a few days a week. The lines are blown out with compressed air.

10. Improper Angle Setting. Standard practice, when setting the machine on a new job, is to red-lead the gear teeth. The head is set at the approximate angle. The gear is next brought into mesh with the master cutter to make an impression, and if slightly off-angle, the necessary correction in angle setting is made and the operation is repeated until a satisfactory impression is made on the gear for a trial cut.

The first trial impression should be made by turning over the cutter by hand to make sure that angle setting is within one minute of final angle setting, as an off angle setting of 15 minutes will engage the cutter teeth on opposite corners of the gear teeth and any sudden upward feed of gear into the cutter, will create a wedging action that may break the teeth of the cutter under power. Operators, when setting master cutters, will eliminate this possibility of cutter breakage by turning over the cutter by hand to produce a fairly satisfactory impression before attempting to apply power to the cutter.

11. Master Cutter bottoming in Root of Gear—Cutter En-

AND IN THIS CORNER

Gear Grinding's Gruenberg
"... probably the most efficient."

Wright's Pfeffer
"Obviously grinding ..."

gaging in Root Diameter of Fillet. This subject is covered under the heading of improperly hobbed or shaper cut gears. Danger of cutter breakage exists when the cutter contacts the fillets of the root diameter. Hob and shaper cutter specifications should be used that will avoid this dangerous condition.

12. Hard Gears. Recommendations for machine tool gears, speed reducers, etc. are gears made of 45% carbon steel, heat-treated to 36 Rockwell, Scale C hobbed and shaved after heat treating. The advantage of this method is a total elimination of heat treat distortion at a small sacrifice of tool life.

When shaving gears up to 45 Rockwell hardness, very good judgment should be used on the part of the shaving machine operator as to the amount of pressure he may apply to the cutter before breakage will occur. Best results as to quality of gears and tool life is obtained when shaving gears up to 36 Rockwell C hardness.

Shoulder Gears

Shoulder gears can be shaved by the rotary crossed axes method. A practical limitation on crossed axes shaving occurs with shoulder gears of different diameters and in close proximity. Lack of space between the individual gears obviously limits the angle at which the axes may be crossed. With a space between gears of ¼″ and with differences in diameter of 1″, shaving can be accurately done.

Each case in this category must be studied individually to determine the most practical axis angularity. This angle may be reduced to five degrees where necessary, without jeopardizing the accuracy of tooth profile, although at as small an angle as five degrees, it is found necessary to increase the working pressure.

In shoulder work, it is not possible to keep the center of the cutter directly over the intersection of the axes due to the lack of room. In this case, it is moved so that its edge is over the intersection. This allows the cutter to be turned end for end to obtain double the service from it.

The use of rotary cutters for shaving gears reduces the product to a common denominator. Also the high cost of other systems of cutting has made rotary gear shaving the standard method for heavy production as well as small quantity production.

Assuming that gear teeth are finish processed in accordance with foregoing discussion, quantity production of timing, transmission and commercial gears having the accuracy of master gears is possible and is attained in every day mass production in many plants.

Three Conditions of Quality

However, three conditions still enter into the quality of the finished hardened gear. (I) Slight misalignment in assembly will cause excessive pressure at the ends of the teeth. Oversize holes in the gear, and sometimes holes that are at the high limit for size, and shafts that are at the low limit will permit misalignment of the teeth of the two mating members. (II) Heat treat distortion of carburized gears causes the helical teeth to unwind, viz.: the lead is often found to increase from that produced in the green before hardening. (III) Heat treat distortion of carburized gears causes the teeth to thicken near the bottom and to become thinner at the top, viz.: the pressure angle is usually found to increase from that produced in the gear before hardening.

The beginning of each new decade has brought forth important developments in the gear industry. In 1920, efficient gear and hob tooth profile testing instruments were made available; 1930 introduced shaving and lapping machines. This year of 1940 also marks the advent of an important development, viz.: the single cam attachment on the circular axes shaving machine, which gives the table a slight rocking motion, and forms the crowned gear tooth or so-called "barrel" shaped tooth. These are also termed "Elliptoid" gears. This motion produces crowned teeth with no additional machine time. The cam can be locked in a parallel plane, if desired. This new development has already been accepted by a number of leading gear manufacturers, and successful results have been attained.

It is now possible to compensate for the three conditions, already mentioned, that affect the quality of the hardened carburized gears. The crown effect reduces the end of tooth bearing to a minimum in cases of misalignment and deflection, due to the fact that the tooth bearing is heaviest in the center and fades out to the ends. The amount of metal removed at extreme ends of tooth is usually .0003″.

This condition is similar to that of spiral type bevel gears, where the central tooth bearing that fades out at the ends is produced by mismatching the radii of the cutters.

To compensate for the distortion in tooth form, viz.: thickening of the tooth near the bottom, a number of concerns use master cutters that produce slightly decreased pressure angles, leaving stock at the top of the addendum of the tooth, measuring .001″ to .002″ plus on an involute gear tooth testing fixture. In some instances, it has been found necessary to slightly decrease instead of increase the pressure angle of cyanided gears, to obtain desired results after hardening. The involute testing fixture in this case reads minus .001″ to .002″, depending on amount of distortion encountered.

To compensate for the so-called unwinding condition of carburized helical gear teeth, a number of concerns are shaving helical gears with decreased lead before hardening. The amount of deviation from theoretical lead is determined by following test pieces through the carburizing and hardening operations. Most companies keep the different heats of steel separate to avoid variation in distortion. Complete control of all the factors entering into the production of finished hardened gears of highest quality is now a reality.

Lapping

Many concerns finish lap hardened gears to obtain the added smoothness of finish, and also correct any slight errors that may be present. Crossed axes lapping machines built similar to the rotary crossed axes shaving machines heretofore described are used extensively. These machines are equipped with power tailstock. The center distance between the gear and lap remains constant and the power tailstock is used to effect a braking action on the work gear, which is driven by the lap. The amount of braking force is regulated to suit the work being processed. One side of the gear teeth is acted upon at a time, and by reversing the rotation at the mid-point of the cycle, both sides of the gear teeth are corrected. In severe cases, where errors are abnormal, cramp action is used, but frequent resetting of the head must be made due to decreased center distance changing the helix angle of the work gear.

Lap crowning in my experience results in chamfering the ends of the teeth, not barrelling the teeth. With proper use of rotary cutters on a crowning machine, an "Elliptoid" curved tooth construction is obtained which requires only occasional lapping for salvage purposes. In one of the largest shops lapping is obsoleted by good rotary shaving. Crowned teeth are in mass production today on truck, tractor and machine tool gears, as well as transmission and timing gears for pleasure cars. The shaving of gears by use of rotary cutters and the crossed axes method can be seen in active use in many plants.

Lapping machines using an internal iron gear lap have been found to give good results in finish lapping gears and pinions having a small number of teeth.

It has been my privilege to be called upon by several companies to do consulting work on gear problems. Elimination of the slow expensive gear tooth grinding operation was one requisite.

Quite a number of small and large spur and helical gears were processed by shaving and lapping as described in this discussion and found to have a smoother and quieter sound in the assembled transmission. It was found necessary, however, to introduce the use of quenching dies for the gear designs that were exceptionally susceptible to heat treat distortion.

Many aeroplane gear drawings specify ground gear teeth. The National Defense program may be retarded due to this very slow operation, as not enough gear tooth grinding machines are available to produce the volume required. Immediate attention should be given the present designs and material specifications, and necessary changes made to facilitate the use of the much faster and more accurate, economical shaving and lapping processes on many component parts.

In summary, producing precision gears by the shaving method requires precision made rigid machines. Shaving and lapping offer a practical, economical means of correcting and finishing gear teeth to improve operating efficiency, to reduce gear noise and to lengthen gear life. Complete control of all factors is now available and mass production of quiet gears is a reality.

III. GRINDING PROCESS OF FINISHING GEARS

by I. J. GRUENBERG
Chief Engineer, Gear Grinding Machinery Co.

THE increased physical properties and long life of the hardened steel gear have fairly well established the use of the grinding wheel for the finishing of gear teeth. The most severe loads, high speeds and precision demands, established by the automotive, aircraft engine and machine tool industries, are satisfied today by the hardened and precision ground gear.

The aircraft engine, with its minimum weight per horse power requirement, the heavy duty bus and truck transmission, the high speed Diesel locomotive gear set, and the precision gears, as used by the machine tool industry, are only a few representative applications.

To utilize the increased physical properties of the hardened steel gear to the fullest extent, it is necessary to correct machining errors and distortion due to thermal treatment. The precision ground gear insures a full bearing across the width of face, thus evenly distributing the load. The true involute and accurate tooth spacing of the ground gear transmit rotation at a uniform velocity which eliminates torsional vibrations and makes for smooth running with long life. The importance of this becomes quite apparent when heavy rotating masses at relatively high speeds are involved.

In addition to the preceding, it may be pointed out that hardened and ground gears generally run much quieter and are probably the most efficient as a class. This however, depends to some extent on the design, loading, speeds and application.

Savings in Grinding

Gears which are to be finished by grinding, effect the following savings which generally cover the cost of grinding:

(1) Heat treatment simplified by elimination of special precautions.

(2) It is not necessary to use special non-deforming steels. Experience has shown that from one heat to another, even these materials are subject to dimensional changes after heat treatment. The grinding stock allowance takes care of these variations.

(3) It is not necessary to hob or cut the gear teeth to great accuracy. The finishing cut is entirely eliminated.

(4) Considerable time saved in final assembly. All ground gears of a set are strictly interchangeable. Practically all disassembly and reassembly is avoided.

There are two types of gear tooth grinding machines on the market, the "formed wheel" and the generating type.

The "formed wheel" machines, for gears up to 16" diameter provide a reciprocating work table and fixed grinding wheel head. On the work table are mounted the index head, tail stock and wheel trueing device. A precision index plate is used for tooth spacing. The grinding wheel trueing mechanism is a reduction pantograph system in which the follower is guided by a master involute cam six times actual tooth size. The master cams are produced on a reduction miller from indicator checked templates 24 times actual tooth size. The larger machines for gears up to 72" have a stationary work table and reciprocating grinding wheel carriage. The trueing device is of the same design as that on the small machines. Indexing on these machines is produced by worm wheel and worm with change gears.

The generating tooth grinders produce the involute and tooth spacing from a master rack and gear. The grinding wheel is trued to the required pressure angle. The single spindle machine has a reciprocating wheel slide and work table actuated by master gear and rack, while on the two wheel machines the wheel heads are stationary.

Accuracy Factors

The accuracy which may be expected in a gear finished by the grinding process may be resolved into several factors as follows:

(1) Involute profile. Because the ratio of the angular displacement of an involute about the center of its base circle to the corresponding tangential advance increment along the pressure line is a constant, an involute may be represented by a straight line. Deviations from this straight line are measured and establish a basis of comparison between different involutes. Master gear involutes are generally held to within .0002 inch and are quite readily produced on a modern precision gear grinder. Production ground gears up to about 12" Pitch Diameter and down to 4 diametral pitch will show an involute contour within .0003 to .0004 inches. Involutes of coarse teeth down to 2 diametral pitch on gears up to 36" diameter can be held to .0005 inch. A number of involute checking machines are available. Most of these are designed to handle the smaller range of gears and diametral pitches. Involutes of large gears and coarse pitches are checked with Odontometers and also by taking chordal dimensions at various tooth heights.

(2) Pressure angle. The pressure angle of an involute is also determined on the involute checking equipment and at the same time the involute is inspected. An error of pressure angle is detected by a gradual deviation from the straight Line representing the involute from base circle to outside diameter. Plus .0001" to minus .0001" may be considered as master gear perfection. The gear ground in production will show a variation from true pressure angle from plus .0002" to minus .0002".

(3) Tooth spacing. Typical smaller machines are supplied with indexing heads with master plates of 9", 12" and 16" in diameter. The spacing of the gashes on these plates is re-

produced exactly on the work and in direct proportion to its size. The 9″ Index Plates show a maximum tooth to tooth spacing error of .0002″. The maximum error over any number of gashes does not exceed .0003″. The total variation between any two notches on the plate is within .0004″. The 12″ and 16″ plates are held to a maximum tooth to tooth spacing error of .0003″. The error over any two gashes is within .0004″. The dimensions given are chordal measurements and about 8% of these show the maximum error. These figures can easily be translated into tooth spacing errors to be expected on the gear to be ground.

(4) Eccentricity. The ground gear rarely shows a pitch diameter run out greater than .0003″ to .0005″. This depends to a great extent on the method of holding the part in the machine and on the fits between it and adapter or arbor.

(5) Taper. This error may be entirely eliminated, or at least to such a degree that measurements taken over diametrically opposite rolls resting on the involute over the width of face show no appreciable deviation.

(6) Tooth thickness. The most convenient and accurate determination of tooth thickness is by the pin or ball method. It is a simple matter to measure the size with ordinary micrometers within a limit of .0002 inch. On production ground gears this dimension over pins is generally held to within .001″, which translated into tooth thickness amounts to about .0004″. This tolerance applies to tooth thickness variation from gear to gear. The chordal thicknesses of the teeth on any one gear are of the same dimension within .0002 inch.

(7) Leads of helical ground gears. Deviations from true lead on master gears do not exceed .0001″ per inch of width. Production gears show errors of lead up to .0002. These figures are based on several groups of inspection reports furnished by one of our good customers.

To produce accuracies in a ground gear such as have been enumerated, careful consideration must be given to the means of holding the work in the machine and the selection of best suited locating surfaces.

Arbor Mounting

Gears with bores through them are generally mounted on arbors, these may be plain or splined depending on design. It is important that the arbor be made to fit the hole closely. The faces of the gear, which are located against the arbor shoulder and locking washer, must be square with the bore. This is particularly critical when more than one gear is mounted on one arbor. Any out-of-squareness of face to bore, when several gears are clamped together, will tend to bow the arbor. The arbor centers must be true with the locating diameters and care should be exercised by the operator to see that they are clean and kept in first class condition. The work drive dog between arbor and the driving mechanism must be of such design as not to cramp the arbor assembly.

Very heavy gears are generally mounted on stub arbors with outboard support provided by tailstock center or pillow block bearing. This arrangement provides a more rigid support than the arbor between centers scheme.

Gears which are made integral with shaft are usually mounted between centers and the drive dog is clamped directly to the shaft. The centers must be of adequate size to insure rigidity.

Gears of very light design, having rather thin webs, are best clamped between large heavy supporting washers on the arbor. This arrangement eliminates any possibility of chatter or vibration when grinding wheel is in contact with work.

Internal gears mounted for grinding are always supported by a special adapter of sufficient depth to clear the grinding wheel diameter. The work is best held in place by several equally spaced hook bolts. The internal gear adapter is located on a stub arbor in the indexing head and used without an out board support.

Center plugs are also used where the design of the part to be ground requires it. These should be of generous proportions with the center holes true to the locating diameter. Thrust shoulders must be square with the pilot diameter.

When a gear must be located on an external shaft bearing, a collet type chuck may be used. Special adapters with internal bore to fit the shaft diameter are also used with good success.

Preparation for Grinding

Gears which are to be finished by grinding are cut or hobbed with a grinding stock allowance. The amount of stock to be removed in grinding is governed by machining errors and distortion due to heat treat. The amount of distortion which may be expected to occur depends in no small measure on the design of the gear.

A gear of large diameter and rather flimsy design would be subject to distortion to a greater degree than one of smaller diameter and sturdier proportions. The correct grinding stock allowance for any particular job can be determined with a few trials. The following recommendations are based on average conditions:

For gears up to 10″ in diameter a stock allowance of from .005″ to .008″ on each tooth flank should be sufficient. From 10″ up to 16″ diameter gears .008″ to .012″. For gears larger than 16″ and ranging up to 72″ in diameter grinding stock allowances of from .015″ to .025″ are used. The coarser diametral pitches generally requiring more grinding stock.

Wherever possible, the teeth should be hobbed to full depth so as to provide clearance for the grinding wheel or wheels. A large amount of material to be removed on the root diameter adds quite considerably to the grinding time. If the root diameter and fillets are to be finished the stock allowance at this point should be reduced to a minimum. Several thousands on the root radius are generally sufficient to clean it up.

Grinding wheels used in the finishing of gear teeth range in size from 3″ all the way up to 30″ in diameter. Vitrified bonded wheels are used, we believe, on most of the gear grinders. Wheels produced by this process are of strong bond and are available in a wide range of grades. They are selected for their ability to remove stock rapidly without generating enough heat to affect the surface hardness. To satisfy this condition, wheels having a soft to medium bond strength are generally recommended for hardened steels. An excessively hard or high bond strength wheel has a tendency to glaze the work, requires frequent trueing and may generate enough heat to produce grinding checks or cracks.

Grain sizes of 46 to 50 generally produce a satisfactory finish, although finer grained wheels of 60 and 70 are successfully used.

Other factors which have to be considered when selecting the correct wheel for a particular material are wheel speed and work speed. Vitrified wheels are normally operated at a surface speed of from 5500 to 6500 S.F.P.M. A change in the surface speed of a grinding wheel has a considerable effect on the action of it. An increase in speed tends to give the wheel a harder action and vice versa.

Work traverse speeds up to 75 feet per minute are used and are varied to suit the grinding wheel diameters, depth of cut and finish desired.

The trueing of gear grinding wheels is accomplished by diamond pointed tools, which are accurately guided over the cutting surface. It is generally conceded that natural pointed stones, crystalline octohedral shapes, are the hardest and consequently show the longest life. Particularly those from the Brazilian fields which seem to give the best service. The

most desirable of these natural crystals have four to five points, which permits resetting to present a new point.

Very satisfactory service also is given by Brazilian diamonds which are set into the tool shank and then lapped to the required shape. When a tool becomes dull it may be relapped very economically.

Factors governing the rate of production which may be expected from a gear grinding machine are as follows:

(1) Number of teeth.
(2) Diametral pitch or size of tooth.
(3) Amount of grinding stock to be removed.
(4) Design of gear to be ground, this governs the size of wheel which may be used and whether more than one gear may be handled on one arbor at the same time.
(5) Degree of accuracy desired in the finished gear.
(6) Quantities involved—small lots naturally require more time than steady production set ups.
(7) Nature of the tooling.
(8) Weight of the piece to be handled.

The grinding time per tooth ranges from about 15 seconds as the lowest extreme and up to about 5 minutes for the heaviest gears and diametral pitches. A fair average production rate for gears such as are used by the machine tool, automotive and aircraft engine industries would be in the neighborhood of 43 seconds per tooth. This figure is based on actual grinding times turned in by our jobbing shop.

IV. PRODUCTION OF GEARS BY GRINDING PROCESS

by CHARLES PFEFFER
In Charge of Gear Development and Production
Wright Aeronautical Corporation

JUST two decades ago the first coast to coast air mail route was established. The phenomenal advance which has taken place since then emphasizes the tremendous development of the American Aircraft Industry. The quickening tempo of national preparedness has created an intense interest in these developments and directs attention to the important part which gear grinding has taken in these achievements. It is the purpose of this discussion to present the gear grinding practice of the Wright Aeronautical Corp. builders of aircraft engines such as the world renowned air cooled Cyclone, to consider the problems encountered and to present the production possibilities.

From the time of the historic flight at Kitty Hawk the constant search for greater power and better engines has continued. The stirring years which followed saw the development of the radial air-cooled engine originally producing 235 h.p., then a further advance by the Wright Cyclone first developing 525 h.p., then 650 h.p. and on to 1200 h.p. and today the Double Row Cyclone at 1600 h.p. and finally the most powerful aircraft engine in the world the Duplex Cyclone of 2200 h.p. Still more powerful engines are within the realm of possibilities and the fantastic dreams of less than two decades ago are an accomplished fact. How was this brought about? Engineering development of course, and the component factors of a highly advanced manufacturing technique, precision and accuracy on a production basis, development of improved materials, refinement of tolerance and surface finish and, needless to say, gears that would function at their fullest capacity and highest efficiency under the loads imposed upon them by these tremendous power impulses. That the problems encountered and the gear requirements for an air-cooled engine differ greatly from those usually found in any other engine plant or similar industry is quite evident, and as will be shown, the character of many of the difficulties are quite individual and very often of a complex nature.

Standard Gear Useless

Gear design experiments and tests gave early indication that the existing standard type of tooth form did not have the necessary characteristics to withstand the loads imposed upon it and that a new aircraft form would have to be developed. To be acceptable for use in an aircraft engine all possible points of stress concentration had to be eliminated. The known and often demonstrated weakness of the root fillet of the conventional type form, and the resulting fatigue failures usually found in highly loaded gears of this type was the first point to receive attention. To eliminate this condition a fully rounded fillet was developed which was adopted as standard for all aircraft engine gears. Following this same line of reasoning it is clear that sharp edges at any point of the tooth profile would also induce strain of a detrimental nature, therefore, it was just as important that all corners of the tooth profile be properly rounded including the root fillet. In addition to rounding all these sections of the tooth profile and fillet it is of equal importance that the surface be smooth and free from any ridges which would cause fracture of the case and subsequent tooth failure.

Spur gears constitute the major portion of all gears used, of which the reduction drive gears are the most critical and highly stressed gear train in the entire engine. They are planetary type gears and transmit the full engine torque to the propeller shaft. As this drive must be as compact as possible it is necessary to reduce the number of teeth in the pinion to a minimum. Involute sections must be used where undercutting would not develop, long and short addendum applied to give the necessary tooth contact or overlap and the teeth proportioned to equalize the load carrying factors. In the earlier engines the stub tooth form was used but the small area of contact and the poor distribution of load from lack of overlap proved inadequate and therefore has been discarded for the full length tooth form. Small pitches and a correspondingly greater number of teeth are favored.

Limitations on Design

There are other conditions and limitations which place severe restrictions on the gear design, such as weight which dictates that light sections must be used to maintain the slightly over one pound per h.p. ratio, this being about one sixth of the weight ratio of an automobile engine; space limitations which often result in gear blanks of such form that they must be processed singly; high speeds which range from 10 to 12 times engine speed, and extremely heavy teeth loads. To fully meet these requirements that gear teeth must be accurate and uniform as to involute profile or form, and parallel to produce a uniform bearing, while normal pitch must be held to close limits so that each tooth in contact carries its full share of the load evenly and without interference. Surface finish must be smooth and free from any extreme wheel or tool marks to prevent any unnecessary friction and to eliminate any fatigue failures which may develop from such defects.

Materials

There can be little doubt as to the importance and the improvement which intense research has produced in the physical characteristics and properties of gear steels in recent years. Carburizing Steels have been improved in quality

and uniformity, and special alloys of certain desirable qualities have been developed. Many of the gears are of case hardening steel where the loads are not severe. Gears which must withstand heavy loads for continuous periods failed due to serious pitting or spalling of the gear tooth surface. For these certain conditions the selection of a steel which would produce an extremely hard case was necessary. Nitraloy, an aluminum alloy steel, was selected as having the necessary properties which would produce the hard surface desired together with a tough core, while still being readily machinable and capable of being hardened by simple processes. The aircraft engine industry was one of the first to use this type of steel for gears and today its application has been extended to many parts where its qualities are desirable. All gears are made from die forgings which are normalized and heat treated before being machined. Specifications are similar to SAE 3312 and 4615 for carburized gears and modified "G" for Nitraloy. Where at all possible carburized gears are quenched in dies when hardening.

Rough cutting of gear teeth follows the usual procedure of hobbing or shaping. From .008 to .010 over the basic tooth thickness is provided for grinding, which, with the backlash allowance, gives .006 to .008 stock to be removed on each side of tooth. Cutters and hobs are of special design to develop the full fillet aircraft standard radius. Because gears are to be ground does not necessarily mean that the preparatory operations can be neglected and that careless, imperfectly cut gears are acceptable. Teeth must be cut to fairly constant thickness and concentricity since heat treatment will develop distortion, run-out and changes which cannot be controlled uniformly or with any positive degree of accuracy. When machining the locating surfaces after hardening, the gears are usually held in gear chucks or from pins to reduce pitch diameter eccentricities and insure uniform case thickness.

Generating and Form Grinding

Gear grinding methods may be placed in two classes: the generating type machines, and the form grinding type. On the generating type the sides of the wheel or wheels represent a rack tooth of a straight side. On the two wheel machines the wheels revolve in a fixed plane and the work is traversed back and forth exactly the same as when a gear is rolled with a rack. At the end of each stroke the gear is automatically indexed and the adjacent tooth is ground, thus for one complete cycle two teeth are ground. The width of face is the limiting factor on this type machine and is governed by the height of the arc created by the wheel diameter. As the major portion of all aircraft engine gears are less than 1-14 inches width of face, this type machine is admirably adapted for such work. It also has the greatest production possibilities as there is only one motion involved, that of the work rolling past the grinding wheels. 20 teeth per minute is the general average of the grinding speed and 6 cuts are usually taken to complete the gear hence a 20 tooth gear would require 6 minutes to finish grind. On the roughing cuts about .0015 stock is removed and the gear is indexed at each end of the stroke. For the finish or final cut about .0005 is removed and the gear is usually indexed only at one end of the stroke. For the size control a predetermined setting of the dial actuating the wheel position is used. After the work has made one complete revolution a ratchet control automatically stops the table in the starting position, and the wheels are moved downward and dressed. On some machines three wheel dressing diamonds are used for each wheel, all actuated by one crank. These diamonds dress the cutting face of the wheel, the clearance side and the diameter, which is especially important when the root fillet radius is to be ground, as the wheels are always in the same plane and of constant thickness. Carburized gears

Production of Gears

Severe restrictions of weight and high standards of performance make standard gears useless for aircraft.

are finished ground after nitriding. This is necessary due to the character of the nitraloy case which has its best section when up to .003 is removed from the top surface, therefore, the tooth is ground to within .004 to .005 of the finished tooth thickness at the semi finish grinding operation.

The single machine wheel is very similar to the Double wheel in operation and has in addition to the rolling action, a reciprocating ram which traverses the wheel parallel to the axis of the gear permitting wider faces to be ground or a number of gears at one time. The grinding speed in teeth per minute varies according to the length of stroke. Due to the wheel construction of this machine rough cuts of .005 and finish cuts of .002 are possible which makes its production rate nearly as fast as the Double wheel when two or more gears are ground at one time. Grinding time for 105 tooth gear 10/36 Pitch is 43 minutes each when mounted two at a time. Usually the operator runs two machines when grinding gears with large numbers of teeth. So far the advantage of this type finish has not been proven. Due to the increased number of cuts necessary to grind the fillet radius as required on aircraft engine gears these machines have a reduced output. In addition to the necessary arbors, Master racks, Gears and ratchets or pitch blocks and dividing plates are required for each type gear ground. These are the tools that control the accuracy of the ground gear and therefore, must be very accurately made and constantly maintained.

Wheels for the generating machines are of saucer type except the single wheel which uses a plain type. 3850 I or J wheels are used, harder wheels would produce better surface finish but would also increase the possibility of burning and would not break down as readily to conform with our standard type of fillet radius since no special means for dressing the wheel corner are provided, wheel speeds are approximately 6000 ft. per minute.

Combination Methods

Involute form splines are used practically throughout the engines as they can be readily fitted and accurately measured. For such splines, internal gears, pump gears and gears where the design does not permit the use of large diameter wheels, form grinding is used. For this type of grinding we use the equipment described by Mr. Gruenberg. In some instances we use a combination of both methods of grinding, as in Nitraloy gears of large pitch and small tooth numbers where under cutting is necessary. The clearance or undercut is produced in the semi-final grinding operation on the generating machine and finish ground after nitride hardening by the formed wheel method, grinding the working face of the tooth up to the under cut. Many of our splines are held to very close limits to secure the desired and necessary fit and when the internal and external members are both form ground, a greater percentage of bearing surface results and, therefore the spline has a greatly increased load carrying

by Grinding Process

The modern gear grinding machine makes extreme accuracy possible with only semi-skilled operators.

ability; Size can be held to fine tolerances and with the special radius dressing attachment the entire tooth firm and fillet may be ground to a very smooth finish. Due to the large grinding area in contact, care must be exercised in wheel selection to prevent burning and grinding checks.

With the exception of a few special cases, all gears are lapped after grinding to remove such wheel fuzz as is produced by the grinding operation and to smooth out any existing wheel marks. Two types of lapping machines are used, one having an internal mating gear type of lap which has the largest amount of true rolling action and therefore, the least tendency to change involute form, and the cross axis type. Lapping can and does produce a fine grained surface and will correct minute errors of irregular rolling action. It can be classified as a refining process and our experience has been that errors in tooth profile, spacing or concentricity cannot be corrected by lapping and that excessive lapping is extremely harmful.

Magnaflux inspection, a method by which the most minute surface cracks are made visible was also first used on a production basis by the aircraft industry. The procedure is to magnetize the part and submerge it, in an agitated bath containing iron dust. Any break in the magnetic flow lines, such as would be caused by a crack, causes a deposit of iron dust making the fault instantly visible. This brought to light a condition of gear tooth grinding for which an immediate solution was not found until oil was used as a medium for cooling while grinding. White and Bagby's Economy gear grinding oil was first experimented with and proved so successful that it was applied to the generating type machines. To insure a quantity sufficient for temperature control, a central oil supply tank was installed with a clarifier for delivering clean and chip free coolant to the work and grinding wheel. This oil permits the wheel to remain free cutting at all times, eliminates wheel glazing and produces a very fine chip rather than the usual wheel dust. Losses due to grinding checks have been practically eliminated since the use of such oil has been adopted.

Accuracy Factors

Accuracy of the ground gear depends greatly upon the type gear blank and the method of locating when grinding. With a well supported gear, it is possible to hold tooth profile and normal pitch to .0002 to .0003 variation and a concentricity of .0005. It would be incorrect to assume that gears ground to such close accuracy would eliminate all further difficulties as many other elements such as gear blank design methods of support and thrust develop deflection under load which must be compensated for. The advantage of grinding is that when these modifications have been determined, they also can be held quite uniformly and accurately. With the generating method, the only form of modification possible is a slight variation in pressure angle producing a high or low flank. With form grinding, practically any desired form of modification can be incorporated in the master former.

With any type machine using masters for control, which are subject to wear, it is essential that the gear grinding set up include means of checking the accuracy of the involute and normal pitch. We have several machines for involute checking which have the gear mounted above and base disc and traces the form as a permanent record through an electrical amplifying and recording device and the Illinois normal pitch checker which compares the successive teeth against a correct setting and registers the teeth to tooth error. This equipment should be used to control the accuracy of Production equipment rather than an inspection procedure. Each grinding machine change over is checked and in certain cases a permanent record is kept of each gear completed. Specifications for case hardened gears control the core hardness to 32 to 46 Rockwell and the case to 58 to 62 Rockwell with a depth of case of .025 to .035. Nitraloy case thickness varies as to the time length of heat treat which is about .025 for 50 hour heat and a Vickers reading of 1000.

Cost was always one of the major objections to gear grinding on a production basis. The Wright Company's experience is that the overall cost must include the quantity of gears which fail to pass the rigid inspection procedure, the rejections which develop at running tests and the quality of service in the field. Judged by these standards, the results have definitely shown that gear grinding is an advancement and technique absolutely essential to the aircraft industry and well within the sphere of Production possibilities. Also to be considered is the simplicity and operation of the modern gear grinding machine making it possible for a semi-skilled operator to produce ground gears efficiently and within the established tolerances.

Other Methods Rejected

Before gear grinding was adopted as a production method for finished gears, many other processes were considered. Finish cutting and lapping could be useful but that correction of the accuracy desired was not possible. Much time, energy and money were spent experimenting with various methods of quenching and quenching dies but it was impossible to hold uniformity due to the varying and light sections necessary. Burnishing was also attempted but soon abandoned as it set up internal strains which caused serious difficulties. Shaving is a gear finishing development which is undoubtedly a forward step and produces far more accurate gears than was possible by earlier methods. When such gears are heat treated after shaving, as would be the practice for aircraft gears, the existing difficulties of distortion would tend to destroy the accuracy produced by this method, therefore, as applied to aircraft gears, this process is of slight advantage. Shaving after carburizing, would introduce the possibility of non-uniform case thickness, a condition not permissible or acceptable.

Our problem definitely remained one which required accurate gears within close limits in the finished state. Obviously grinding, after hardening, was the only method by which the existing difficulties could be corrected, therefore, production gear grinding is the accepted practice throughout the aircraft industry and the Wright Aeronautical Company was one of the first to have a production schedule involving gear grinding.

In concluding, it may be of interest to know that: 80% of all spur gears are ground, 20% of all external splines are ground, 10% of all involute internal splines are ground, and 40% of all external square splines are ground.

THE END

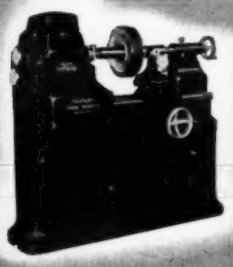
Presenting the New

ILLINOIS ELECTRICAL RECORDING SYSTEM!

INVOLUTE PROFILE MEASURING MACHINE
(with Electrical Recorder)
Checks the accuracy of gear and shaper cutter tooth profiles which are designed to the involute system.

BASE PITCH and SPACE MEASURING MACHINE
(Available with Electrical Recorder)
Measures base pitch of spur and helical gears, or spacing of spur, helical, bevel and worm gears in the rotational plane.

HELICAL LEAD MEASURING MACHINE
(Available with Electrical Recorder)
Determines the accuracy of lead on helical gears, checking from zero lead to infinite lead.



Close-up view of "Recorder"

Close-up view of "Red Head"

A Practical, Accurate Method for Permanently Charting Gear Measurements!

● The new ILLINOIS Electrical Recording System is composed of two distinct units, as follows:

(1) The "Red Head", which is attached to the measuring machine and receives its movement from the dial indicator contact finger.

(2) The "Recorder", a separate portable unit on roller mounted pedestal, which magnifies the movement of the "Red Head" and produces a chart simultaneously with the checking operation.

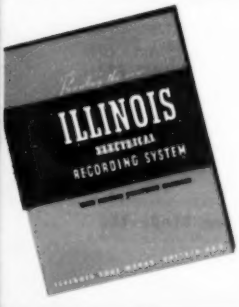
Among the inherent advantages of the ILLINOIS system are—

(1) A single portable "Recorder" will serve the requirements of several measuring machines equipped with "Red Heads".

(2) A record of all three essential elements in gearing (involute profile, base pitch and helical lead) may be kept together on one chart.

(3) The system may be applied to other measuring machines employing a dial indicator.

WRITE FOR DESCRIPTIVE FOLDER



A complete description of the new Illinois Electrical Recording System and what it offers you in improved inspection operation is available in an illustrated folder. This literature also shows the complete line of Illinois Measuring Machines. Be sure to write for your copy today!

ILLINOIS TOOL WORKS

HIGH SPEED ILLINITE PRODUCTION TOOLS
AND SHAKEPROOF PRODUCTS

2309 N. Keeler Avenue • Chicago, Illinois
In Canada: Canada Illinois Tools, Ltd. Toronto, Ontario

Limit Switches

How to limit spoilage resulting from operator's slips through the use of limit switches.

by

GEORGE A. HIGHBERG

Chief Engineer, Cushman Chuck Co.

Hartford, Conn.

WITHIN the experience of all Tool Engineers are machine operations which require, on the part of the operator, a fixed sequence of movements which must be followed by him in order to produce the desired machining. It is also well known that where such a choice is left to operator, the frailty of human nature is such that sooner or later the correct procedure is not followed with the inevitable result of work spoilage, tool breakage or even a machine breakdown. Operations performed on automatic machinery do not fall into this class as its function is mechanically prearranged.

The purpose of this article is to describe a particular operation of a type which necessitates changing of tools in a single spindle machine for each stage of its operation. Similar types of work abound which can profitably adapt themselves to controls of a similar character to the one about to be described.

At the plant of the Cushman Chuck Company, chuck bodies are drilled and reamed to receive the operating pinions. In *Figure 1* is shown a special hydraulic single spindle drilling machine and special note should be taken of the tool holder attached to the face of drill head just above spindle as well as the square indexing dog holder. The operations performed after chuck body is securely attached to large index table are first to drill thru the outer shell of body with a large diameter drill. This is then removed by means of a quick change collet and a smaller drill inserted which drills hole for small end of pinion considerably nearer to work center than the previous drill. Upon removal of this drill a special reamer reams both holes simultaneously.

Attached to drill head, as referred to

(Continued on following page)

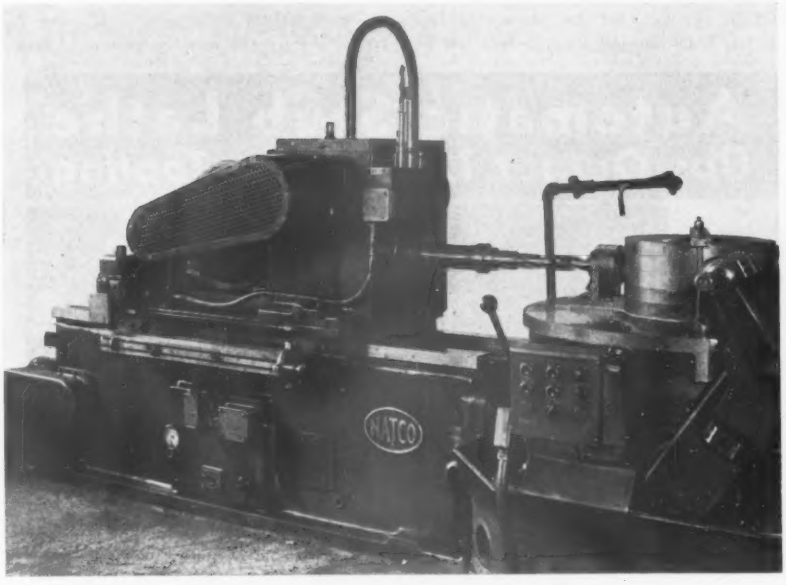


Figure 1. Single-Spindle Drilling Machine
Take special note of the tool holder.

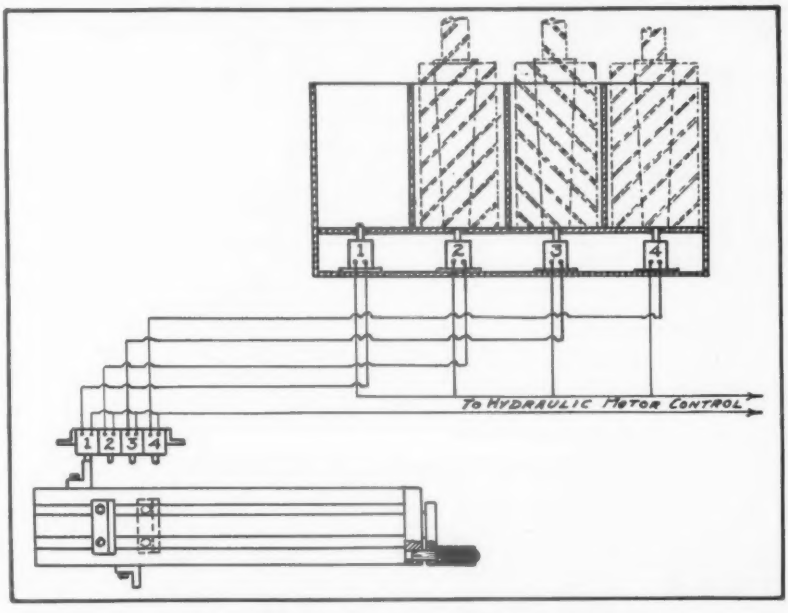


Figure 3. Schematic diagram of limit switch layout.
To operate machine, the circuit must be closed.

LIMIT SWITCHES

(Continued from preceding page)

above, is a square T-slotted block which is indexed by the operator with the index handle attached to it and on each face of this block are attached dogs which control the rapid approach of drill slide, the feed, dwell and quick return for each tool. It is, therefore, obvious that this index bar should be set at the proper position for each tool to control the proper functioning of depth, etc. Assuming now that the operator has the large drill in spindle and the index dog bar has not been rotated by him but left in its previous position for reaming, the result would be work spoilage because in this case the large drill would go far beyond its proper stop. Any number of other and similar wrong combinations can also result as we discovered to our sorrow but since installing the simple holder and limit switch arrangement, no further losses from this source have resulted inasmuch as the machine will not operate at all unless the correct position of cam holder and tool are maintained.

Limit Switch Arrangement

Upon completion of its operation, each tool is placed into its indvidual pocket in the tool holder as shown in *Figure 1.* Extending up and into the bottom of each pocket is the plunger of a limit switch of the normally closed type. Each of these limit switches are connected in series with a secondary group of limit switches, attached to the rear of spindle head as shown in *Figure 2.* This last group are of the normally open type and are closed when roll of switch is depressed by its mating cam block attached to the index bar. In *Figure 3* is shown a schematic diagram of the switches, the holder, the index bar, the cam block and the wiring.

Assume that the large or first drill is removed from its pocket. This first limit switch then snaps closed but as the remaining tools are left in holder, the other lines are open. In order to complete circuit, operator rotates stop holder to No. 1 position which closes the mating No. 1 switch by coming into contact with the proper cam. The machine is now free to move forward for its operation and the proper feed and stop dogs are in their right position for this drill. If any other drill were removed when the stop bar was in No. 1 position, or if any other position of stop bar was not correct for its proper tool, the machine would not move forward until the oversight was corrected. As the spindle slide moves forward thru the action of a motor, operating the hydraulic pump, and because the above described circuit is interlocked with the control for this motor, circuit must be closed to operate machine.

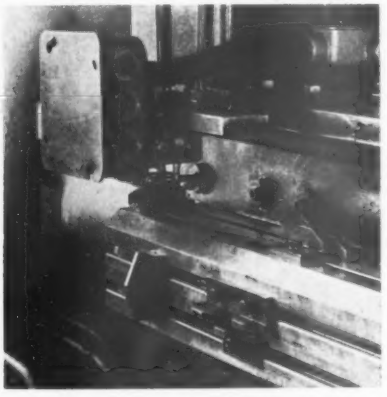


Fig. 2. Rear of spindle head. *These are secondary switches.*

Toronto Scene of Next Fall Meeting

For the first time in its history, the American Society of Tool Engineers will go outside of the United States for a convention meeting. Toronto, Canada, has been selected as the site for the 1941 Semi-Annual meeting of the A.S.T.E., to be held next October, according to an Announcement by the Board of Directors of the Society.

The Annual Meeting, the week of March 25th, is scheduled for Detroit in conjunction with the 1941 Machine & Tool Progress Exhibition.

New Literature

Of Interest to the Tool Engineer

(100) Hobbing Data

Hobbing Data, Case Histories of Field Performance. Barber-Colman Co., 213 Loomis St., Rockford, Ill. This handsome book offers in the first 32 pp. a condensed catalog of all the B-C machine and small tool items. The book also contains the first six of a projected series of Data Sheets, each of which tells the complete story on a specific production hobbing operation. Available on request to superintendents, foremen, production engineers, master mechanics, and others of the same type.

(101) Band Saw Blades

DoAll Saws. DoAll Saws Company, Des Plaines, Ill. 32 pp. This booklet describes the variables found in several types of narrow saws, shows how they are used and gives cutting speeds for various materials.

(102) Vertical Profiler

Morey No. 12M Vertical Profiler. Morey Machinery Co., 410 Broome St., New York City. 8 pp. This folder illustrates, describes, and gives specifications for this vertical profiler.

(103) Power Hack Saws

Peerless Standard Metal Cutting Saws, Bulletin 52. Peerless Machine Company, 1600 Junction Avenue, Racine, Wisconsin. 10 pp. This booklet includes the standard line of saws and some other models. It also gives recommendations for the correct uses of high-speed steel blades in various kinds of steel.

(104) Data Sheets

Gisholt Performance Data Sheets. Gisholt Machine Company, 1229 East Washington Ave., Madison, Wis. 6 pp. These sheets describe representative metal-turning jobs performed on turret and automatic lathes, and an example of static-dynamic balancing on a Dynetric Balancing Machine.

HOW TO ORDER

Booklets listed in these pages or information on new equipment may be obtained by using the post card bound in this issue. Merely fill out one coupon for each item desired, being sure to print plainly and to include position and company. Mail the card to us and you will receive the information desired at once.

(105) Cutting Lubricants

Cutting and Grinding Facts. Sun Oil Company, Dept. 7, Philadelphia. 60 pp. This booklet includes machining data on the latest lathes, milling machines, hobbers, drillers and grinders. It includes such information as: operation, machine used, materials being machined, spindle speed, depth of cut, feed and cutting lubricant used.

(106) Welding

Spot Welders by Acme. Acme Electric Welder Company, Huntington Park. Calif. This folder contains illustrations, features, and specifications of the Acme line of Air operated rocker arm type spot welders.

(107) Lathes

Morey 27 Manufacturing Lathe. Morey Machinery Co., 410 Broome St., New York City. This folder gives description and specifications of the Morey 27" lathe. which is available with a special shell turning carriage.

(108) Lathes

Fay Automatic Lathe. Jones and Lamson Machine Company, Springfield, Vt.

(Continued on following page)

NOTHING BETTER

● Chicago Rawhide hammers and mallets, made from genuine Java Water Buffalo hide, are a first choice wherever pounding must be done on surfaces that must not be damaged.

Accurate—Economical

Hammers have malleable iron heads—an indestructible feature—and replaceable faces.

Mallet heads are tightly coiled and riveted —made to strike hard blows without "mushrooming", splitting or chipping.

● Chicago Rawhide Tools are available thru your supply dealer. Ask him to demonstrate the quality of these tools.

CHICAGO Rawhide MFG. CO.
1393 - ELSTON AVE · CHICAGO · U·S·A·

NEW!
CENTER GRINDER *and* DRILL PRESS

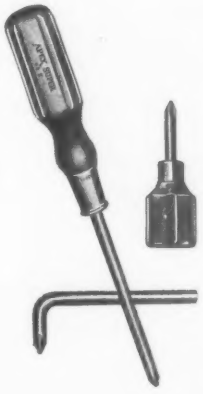
Gives you two machines for the price of one! Center Grinder dresses the angle accurately and assures accurate grinding on successive operations. Easily changed into a sturdy, accurate Drill Press of 1/2-inch capacity—simply loosen one bolt, raise dresser up to full height and swing out of way. Floor type, can be furnished in any length, complete with motor, diamond and grinding wheel. Four speed V-belt drive to handle any range of work.

$197.50 Standard grinder, 40" between centers, complete with 110-220 volt motor.

F.O.B. Detroit
Write for Bulletin No. 11

DALZEN MANUFACTURING CO.
511 LEIB ST. DETROIT, MICHIGAN

APEX
-PHILLIPS
HAND DRIVERS



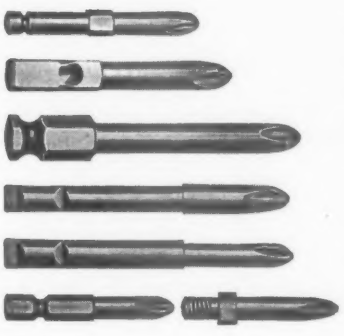
Made in two types — General Purpose and Super Service. Super Service Drivers are for case-hardened, self-tapping screws. Available for all sizes of Phillips screws and in "Stubby" drivers for close quarters work. Both types and all sizes can be had with transparent break- and shock-proof handles.

"L" Drivers for Phillips screws are made for all sizes Phillips screws and in single and double-end drivers.

Service Drivers are available for assembly tee handles, ratchets, extension shanks, speeder handles, etc.

Hand Brace Bits are made for all sizes of Phillips screws with either Super or General Purpose blades.

and POWER BITS



APEX - Phillips Power Bits are made of a special shock - resisting steel, heat treated to give maximum hardness, toughness and wear resistance. Special bits are made for case - hardened, self - tapping screws.

APEX Power Bits are available for nearly all makes of electric, air and spiral drivers for Phillips, Slotted Head and Clutch Head screws.

The
APEX MACHINE & TOOL
Company
1101 Patterson Blvd. Dayton, Ohio

NEW LITERATURE

(Continued from preceding page)

18 pp. Complete information on the Fay 12" lathe.

(109) Cutting Tools

Kennametal Prise List. McKenna Metals Company, 600 Lloyd Ave., Latrobe, Pa. 16 pp. This list gives the new reduced prices on the complete line of Kennametal-tipped tools, blanks, milling cutters, and lathe and grinder centers.

(110) Carbides

Machining Steel with Carboloy Tools. Carboloy Company, Inc., 11145 E. Eight Mile Road, Detroit, Mich. 16 pp. This bulletin covers tool design and selection, use of coolants, chip breaker design and use, grinding of chip breakers, tables covering speeds, feeds, and depth of cut, etc.

(111) Gear Finishing

Eleven New Folders. Michigan Tool Company, 7171 E. McNichols Road. Punched for ring binder, these eleven folders describe and give the specifications for the Michigan Tool line of Gear Finishing, Lapping, and Checking machines.

(112) Presses, Punches, Shears

Niagara Machines for Plate and Sheet Metal Work. Niagara Machine and Tool Works, Buffalo, N. Y. 68 pp. A condensed resume of the complete Niagara line of presses, punches, squaring shears, and rotary shears.

(113) Turret Lathes

Turret Lathe Earning Power. Jones and Lamson Machine Co., 28 pp. This elaborate brochure presents and answers twelve fundamental questions which form a basis for the comparison of turret lathe values relative to the earning power of the machine.

(114) Electric Tools

Skilsaw Portable Electric Tools. Skilsaw, Inc., Chicago. 60 pp. This catalog illustrates and describes the complete line of Skilsaw Portable Electric Tools. Working pictures and specifications are included.

(115) Milling Machines

Fray All Angle Milling Machines. Fray Machine Tool Co., 515 West Windsor Road, Glendale, Calif. 8 pp. Descriptions, illustrations and specifications of the Fray No. 7 Milling Machine. Also a 12 pp. booklet of milling attachments.

New Motion Picture

Steel for the Ages, a production of the Allegheny Ludlum Steel Corp., 2319 Oliver Building, Pittsburgh, Pa., is a new sound and color film which deals with the manufacturing of Stainless Steel from the melting furnace to the finished products. Many shots of tapping, teeming, cogging, rolling and drawing Stainless Steel, make it most interesting, according to the producers.

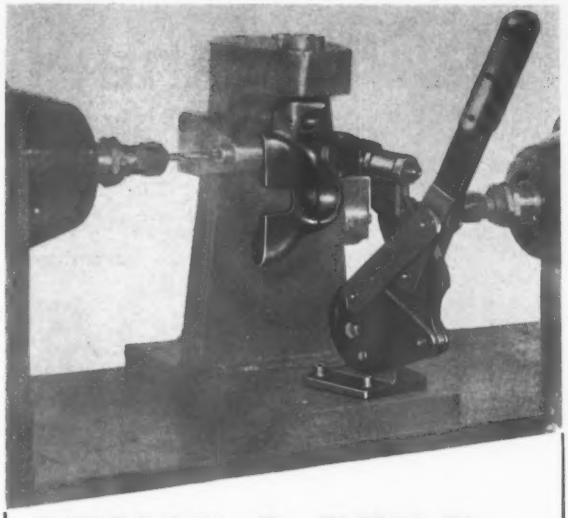
Groups interested in showing the film are invited to contact the producer for bookings.

Seybold
Precision Knife Grinder (76)

A newly designed Precision Knife Grinder, a high speed machine with automatic grinding wheel feed and centrifugal pump cooling system, is offered by the Seybold Division, Harris-Seybold-Potter Company, Dayton, Ohio. Removing an absolute minimum of metal, this grinder is said to quickly produce a keen, true cutting edge that requires little honing.

It does not require an experienced operator, it is claimed, and is said to grind equally well almost all straight knives in general use—either shear or beveled. A unique feature is a hollow three-sided knife bar, each surface presenting a different series of angles to the action of the traveling grinding wheel. A fourth open side makes it easy to bolt or clamp various types of blades to the bar.

All gears and clutch operate in an oil bath to insure quiet, trouble-free performance. The machine comes in three standard sizes: 70", 100" and 128" lengths.



DESIGN & BUILD—

KNU-VISE TOGGLE CLAMPS into those high production fixtures. Cam action enables work to be held that varies in thickness, toggle linkage release clamping bar from work with more speed. Hinged base for flexibility of installation.

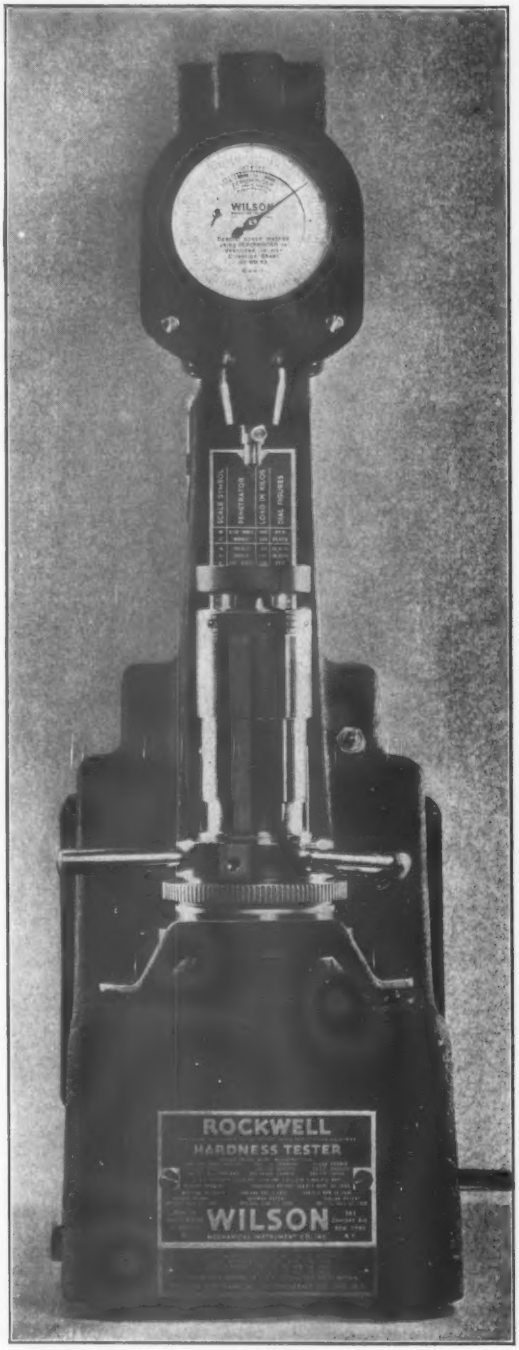
KNU-VISE INCORPORATED
16837 Hamilton Detroit, Mich.

MORE SPEED LONGER LIFE
with PUTNAM END MILLS

In an operation such as that illustrated —milling 3/8" slots in a die block— Putnam End Mills permit the maximum speed and feed. In addition, manufacturing and heat treating methods assure long, trouble-free service. Why not prove to your own satisfaction—by actual use on your machines—that the end mills which do "cut faster and last longer" are produced by Putnam?

PUTNAM TOOL COMPANY
2987 Charlevoix Ave. • Detroit, Michigan

"ROCKWELL"
Motorized
HARDNESS TESTER

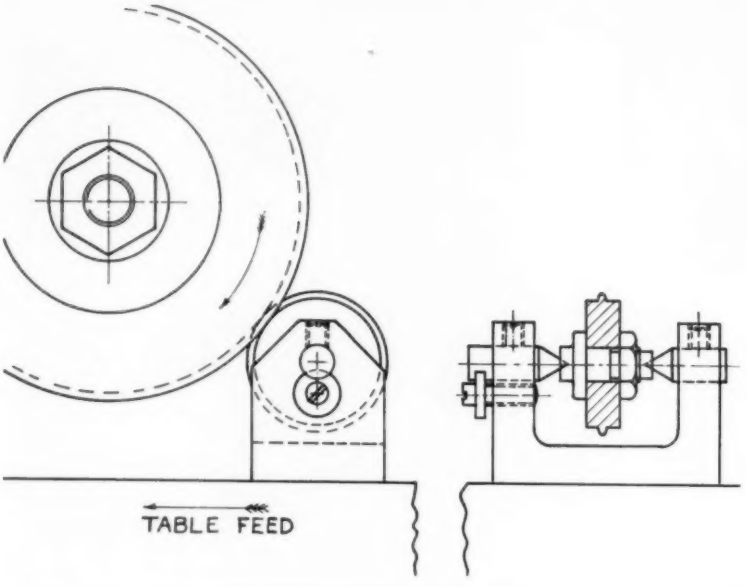


for 100% inspection in mass production

380 Concord Ave.,
New York, N. Y.

WILSON
MECHANICAL INSTRUMENT CO., INC.

Form Dressing Grinding Wheels



by
E. J. SAETTEL
Binghamton Chapter, A. S. T. E.

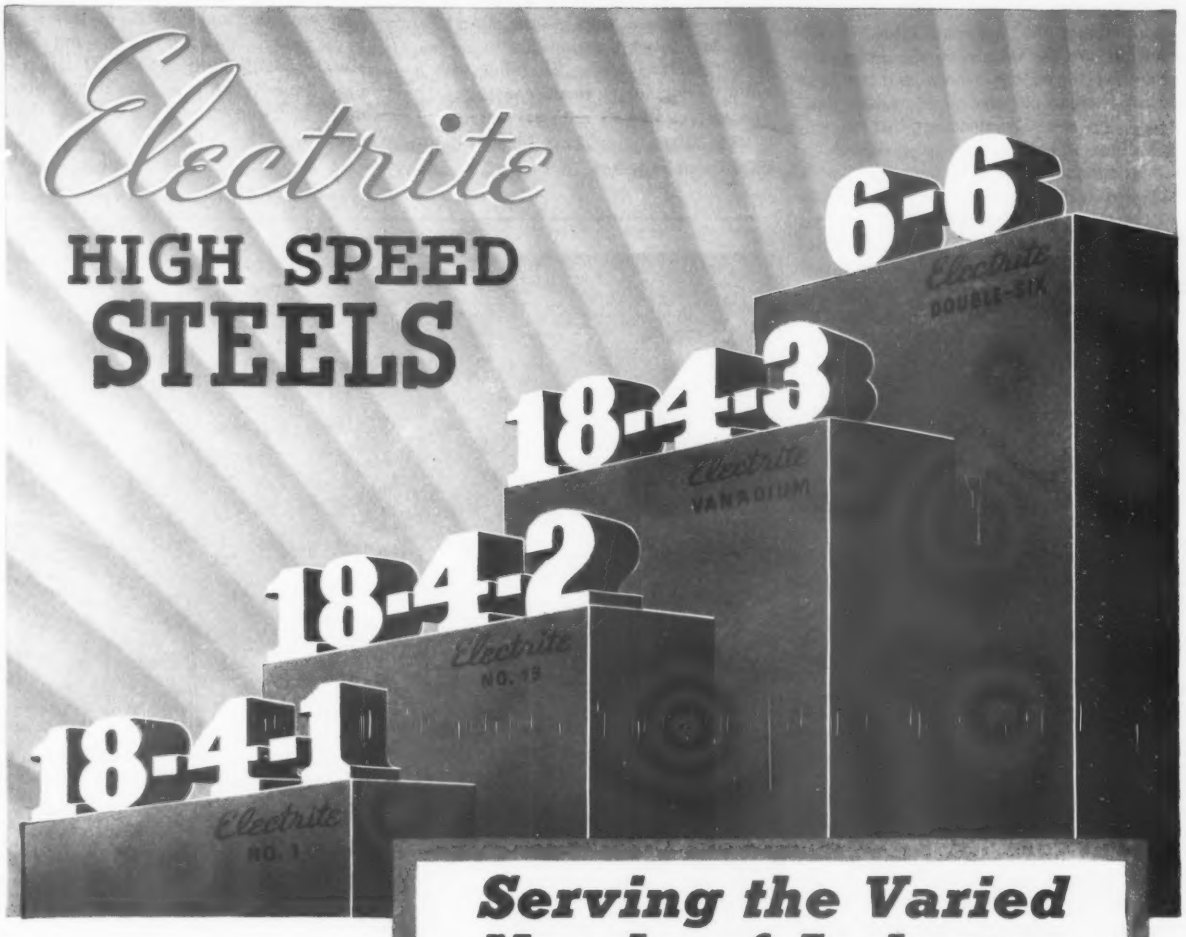
How to form dress grinding wheels economically when dressers are not available.

A VERY satisfactory method for form dressing grinding wheels may be economically utilized when dressers are either not available or applicable for the requirements.

This method necessitates the use of a unit consisting of a hardened tool steel forming tool supported on dead centers *(see cut)*. On the forming tool is the

(Continued on following page)

LATROBE



Introducing

DOUBLE-SIX

This newest member of the ELECTRITE group, because of its 6% Tungsten and 6% Molybdenum content, possesses unusual toughness and freedom from decarburization. Electrite DOUBLE-SIX is more refined in grain size and structure, with improved cutting efficiency, and is low in ultimate cost. Write for Bulletin.

Serving the Varied Needs of Industry

The name ELECTRITE has become a symbol for assured dependability . . . a definite mark that guarantees enduring service and uniform quality in high-speed steels! Up-to-the-minute testing apparatus, the latest mill equipment employing the most modern technique, and practical, experienced specialists are available to help you secure the proper ELECTRITE tool steel for your particular application.

Write for Bulletins.

4

Latrobe ELECTRIC STEEL COMPANY

MAIN OFFICES *and* PLANT · · LATROBE · PENNSYLVANIA

FORM DRESSING

(Continued from preceding page)

form which is to be reproduced on the work, in this instance, it is a gear tooth shape. For dressing the shape in the grinding wheel, the unit, which is mounted on the machine table, is advanced until the forming tool contacts the stationary grinding wheel and is held firmly in place by use of the table hand feed. Pressure is then applied to the grinding wheel which is revolved at greatly reduced speed. The reduction in speed may be obtained by manipulation of the start and stop buttons. When the desired depth of the form tool has been dressed in the grinding wheel, the pressure may be released and the forming tool pulled clear of the wheel.

To obtain satisfactory results it is necessary that,

1st. The wheel must be stationary when first contacting the forming tool.

2nd. Constant pressure must be maintained on the forming tool during the dressing operation so that the grinding wheel and forming tool revolve at the same peripheral speed.

3rd. The speed of the grinding wheel must be greatly reduced because normal speed creates sparks which results in the destruction of the forming tool.

The method is applicable to any grain of wheel and pre-rough dressing is not necessary. To clarify any question relating to the forming tool, it has the appearance of a B. & S. circular form tool before gashing.

With a finely adjusted machine and set-up, ground work within .001" of the forming tool size has been obtained with the use of an unground aero-cased S.A.E. 1015 forming tool.

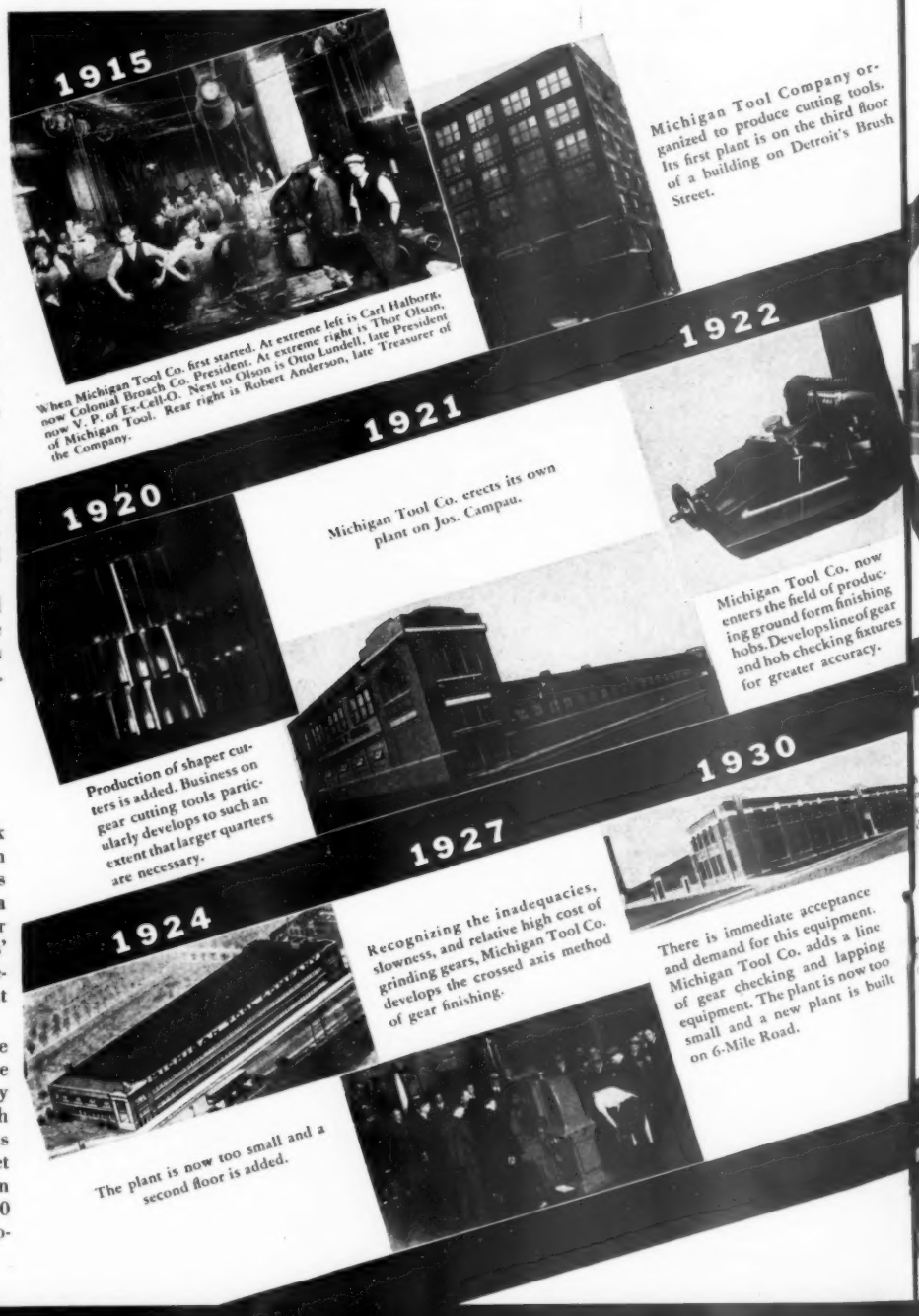
Machine Tools Called First Line of Defense

Vital parts of airplane engines, tank motors and anti-aircraft guns, made on machine tools, must be accurate to less than one-tenth of the thickness of a human hair, Tell Berna, general manager of the National Machine Tool Builders' Association, told members of the Cleveland Engineering Society at a recent meeting.

"The extent to which war has become mechanized," Berna said, "may be summed up in the statement that today it takes only 1500 men to throw as much metal on the target in a given time as 20,000 men could throw on that target during the last war. But these 1500 men must have from $2,000,000 to $2,500,000 worth of equipment, including equipment enabling them to move over 100 miles a day and communication equipment to keep in touch with headquarters—and they must have the mechanical skill and the engineering knowledge to operate this equipment.

"War today is fought by small groups of men who know how to operate machines. The machines do the actual fighting. And these machines are made largely by machine tools. Therefore the machine tool industry today constitutes part of the first line of national defense.

"The manufacturer of modern fighting equipment requires, first of all, amazing accuracy. Essential parts of airplane engines, of tank motors, and of the recoil mechanism of anti-aircraft guns, for instance, must be accurate to within two ten-thousandths of an inch—less than one-tenth the thickness of a human hair. These parts are made on machine tools and therefore this accuracy must be built into machine tools. Without this accuracy, today's planes, guns, and tanks simply could not function. It might almost literally be said that today victory may be won by less than a hair's breadth."



» » A.S.T.E. DOINGS « «

By IRWIN F. HOLLAND

Detroit

Detroit's November meeting, at Hotel Fort Shelby, drew a full house, indicative of interest in A.S.T.E. activities. Fred J. Schmitt, Secy. of Chicago Chapter, was among the distinguished visitors, as was Ford R. Lamb, Exec. Secy. who also sat "above the salt." Among a considerable quota of A.S.T.E. key workers present, one noted A. Sargent, consulting engineer whose years of faithful service as first National Secretary and work on various committees has been a high light of A.S.T.E. progress.

Others were D. A. Samson, Works Manager of Dodge Brothers; E. J. Hunt, Works Manager of the Chrysler Tank Arsenal; Charlie Thiede, who is now Master Mechanic at the Chrysler Jefferson plant; Bill Smila, now Master Mechanic of Plymouth; Otto Franke, now Master Mechanic of Dodge; and Frank Morisette, Staff Master Mechanic of the Chrysler Corporation.

Two speakers had been engaged, both treating timely topics, while a movie on aviation provided an interesting interlude once a few "bugs" in the electrical system had been ironed out. F. E. Searle, Superintendent of Henry Ford Trade School, spoke on "Importance of Engineering Preparedness," and the educational work necessary to shape public opinion to acceptance of the value of mechanical training. He quite impressed upon his audience the importance of manual training as a foundation for important executive positions in Industry. (In this reporter's opinion, Ford Motor Company is to be commended for its place among industrial leaders in the training of youth. The sooner we all learn to respect the dignity that goes with mechanical skill, the better for the nation.)

Kenneth Sutton, Production Manager of Wright Aeronautical Corp., spoke on the "Problems of Manufacturing Aviation Motors." While quite technical, Mr. Sutton's expression was easy on his hearers. He showed that he "knew his stuff" and his mastery of subject rendered his portrayal highly educative at a time when aviation is of paramount importance in the national defense Program. The one speaker stressed the importance of manual training and skill, its value as a background in engineering; the other proved its application in the engineering and building of a highly refined masterpiece of engineering. Detroit Chapter officers are to be complimented for arranging a meeting so rounded out and interesting.

Cleveland

Approximately one hundred and three members and guests attended the November meeting of the Cleveland Chapter held at the Hotel Allerton ballroom on Friday, November 8, 1940.

The after-dinner speaker for the evening was Mr. Al Sutphin, Cleveland sports celebrity and owner of the Cleveland Barons Hockey Team. Mr. Sutphin related many amusing anecdotes in the field of hockey and provided the members with interesting highlights and bylights in this sport.

For the technical session, the members

(Continued on following page)

A. S. T. E. DOINGS

(Continued from preceding page)

were privileged to hear Mr. J. C. Grindley, Sales Manager of the Watson-Stillman Company who chose as his topic the unusual subject, "Hydraulics Under the Sea." Other guests present were Claude Forsberg, Assistant Works Manager and H. C. Sproule, District Representative of the Watson-Stillman Company.

Aided by small models, Mr. Grindley demonstrated how man performs superhuman engineering feats in building tunnels that run through solid rock and sand and under river beds. Tunnel building is a highly dangerous job because of the great air pressure under which the "sandhogs" work and because of the constant possibility of a cave-in.

One of the most interesting problems ever undertaken by the Watson-Stillman Company was the building of a steel diving bell for Dr. Beebe, famous underseas explorer. Mr. Grindley related the many difficulties encountered in the building of this bell; i. e., the necessity for obtaining glass of the right thickness and strength to be installed in the three portholes, the difficult problem of fitting this glass so that no water would seep through when the bell was subjected to the great pressure under the sea.

After the Bathysphere (the name applied to the diving bell) was built and thoroughly tested, Dr. Beebe did what no human had ever done before, namely, descend one-half mile below sea level for the purpose of photographing the weird denizens of the deep and obtaining scientific data concerning marine life in the undersea depths.

In his closing sentence, Mr. Grindley exhorted the members to cooperate to the fullest extent in order to make certain that the gigantic defense program undertaken by the present administration would be completely successful.

Milwaukee

A turnout of 110 members and guests on Thursday evening, November 14, greeted the speaker, Mr. Francis Trecker, Assistant Chief Engineer of Kearney & Trecker Corporation.

He gave an excellent talk on the New Technique in the Art of Tool and Die Making. This was illustrated by various slides showing the novel features and ease of operation of the new Tool and Die Miller.

After his talk Mr. Trecker showed a colored talking movie "The Rotary Head Tool and Die Milling Machine." This movie traces the "Die Miller" from the layout board to its completion; and shows it in operation performing each of the many jobs that it is designed to do, such as cherrying both male and female, laying out the die, boring, drilling, radial feeds, angular feeds, etc. A great many dies and die castings were on display for those who wanted to see the finished work.

An unexpected pleasure was the visit to our meeting of Mr. Roy T. Bramson, Editor of the TOOL ENGINEER; and Mr. J. A. Ashburn, Associate Editor from Detroit.

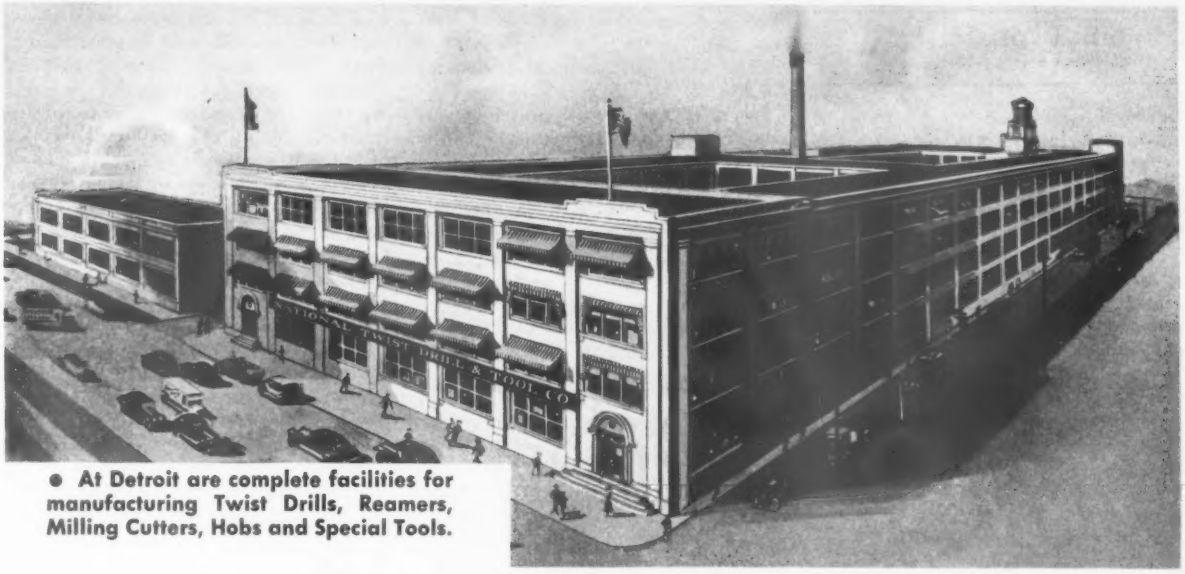
In spite of the unseasonal snow storm, several visitors were present from Grafton, West Bend, Waukesha and Racine.

One state manufacturer has asked if his company may sponsor a membership in the A.S.T.E.. as he has several men that he wishes to send regularly to the meeting. The request has been referred to the membership committee for action.

Chicago

The October meeting of the Chicago Chapter was held at the Midwest Athletic Club. The speaker of the evening was Mr. Flanagan of the Jones & Lamson Machine Company, who gave an interesting talk on "Thread Grinding," which was received with considerable interest. Mr. Flanagan also showed slides of turret lathes, pedestal comparators, and other equipment. A long discussion followed the talk.

(Continued on following page)



• At Detroit are complete facilities for manufacturing Twist Drills, Reamers, Milling Cutters, Hobs and Special Tools.

• At Wrentham, Mass.—Winter Bros. Co.—are facilities for making standard and special Taps and Dies.

FACILITIES

• These two units combine to serve the needs of Metal Cutting Tool users from coast to coast—and abroad.

NATIONAL TWIST DRILL & TOOL CO.

TWIST DRILLS • REAMERS • HOBS • MILLING CUTTERS • COUNTERBORES • SPECIAL TOOLS

Home Office and Factory—DETROIT, U. S. A.

Tap and Die Division—WINTER BROS., Wrentham, Mass.

Factory Branches • New York • Chicago • Philadelphia • Cleveland • Distributors in Principal Cities

A. S. T. E. DOINGS

(Continued from preceding page)

Hartford

Monday evening, November 4, the Hartford Chapter again turned up in heavy numbers for the monthly technical sessions at the Hartford Gas Company auditorium.

The technical session was presided over by the meeting Chairman, Mr. George Pearse, Jr., who introduced the speaker, Mr. C. A. Hooper, Tool Supervisor, Chevrolet Motor Car Company, Flint, Michigan, whose topic "For Longer Tool Life" produced a very instructive talk on ways and means of prolonging tool life.

Cast high speed steel proved a very interesting method of producing harder wearing surfaces and the Chevrolet method of brazing soft steel to worn out short lathe tools to lengthen their life was also well worth consideration by Tool Engineers.

Pittsburgh

Pittsburgh Chapter held their own in sending quite a few of their boys down to Cincinnati for the Semi-annual meeting. They were Messrs. Weaver, Pierce, Ford, Thoas, Brandt, Ralston, Moelter, Rose and Grace. A very worthwhile meeting seemed to be the opinion of those who made the trip.

At the November 1 meeting which was again held at Stouffers in Pittsburgh, we had 65 out for Dinner and 69 at the meeting, Mr. J. R. Longwell of the Carboloy Company gave a most interesting talk on Cemented Carbides, which he illustrated with slides. Several of the boys made a most interesting discussion after the talk was ended and found that they are now recommending some entirely new practices as to the use of tool shapes on carbides for the turning of steel. We do learn something everyday if we just put a little effort in the right way.

The educational committee is being organized on what seems to be a real basis and by next meeting there is expected to be a real committee functioning in the right direction. Chairman, "Wib Pierce" is withholding the Chairman of this Committee until that date.

Toledo

Toledo's November meeting was held Tuesday, November 12 at the Toledo Yacht Club. The speaker of the evening, Mr. C. B. Shaffer, engineer of the Libbey-Owens-Ford Glass Company of Toledo, presented an excellent talk on sheet glass and illustrated with talking pictures and glass samples. The material and the machinery used in processing plate, flat and safety glass were very well explained, and we all learned something from this presentation.

Toledo's Rennell
The spark plug transferred

Due to the rush in Toledo's busy plants, many of our regular attendees were kept busy at work on their respective jobs while the others were dining and enjoying the program. This cut our attendance to about forty-five.

The most noticeable absentee at this meeting was our spark plug of a chairman, Larry Rennell, whose own efforts in the past have been perhaps the greatest influence in the organization, growth and success of the Toledo Chapter.

(Continued on following page)

A. S. T. E. DOINGS

(Continued from preceding page)

Mr. Rennell's resignation, due to his leaving Toledo to join the organization of the Bendix Products Company at South Bend, Indiana, was read by L. E. Kelly at this meeting, and although we deeply regret his leaving, we wish him every success in his new position.

With Larry Rennell, we also lose Milton Richardson and Carl Wolfert, active A.S.T.E.'ers, who also will be with Bendix at South Bend.

Twin Cities

Forty-three members and guests attended the dinner and many more joined the lecture given by the A.S.T.E. Twin Cities Chapter at Dunwoody Institute, October 16.

Mr. George W. Wise, Chairman, presided and after a short talk called on Mr. Erik O. Wistrand. Mr. Wistrand gave a short talk spiced with good humor and introduced the speaker of the evening, Mr. John A. Markstrum, Chief Engr., Continental Tool Division of Ex-Cell-O Corp. Mr. Markstrum gave a fine talk on Broaching and Thread Grinding, which was illustrated with slides showing the latest methods and equipment.

Baltimore

On Wednesday November 6 the regular monthly meeting was held. It was the good luck of "old 13" to have as its speaker, Mr. W. W. Edens, Chief Metallurgist of Ampco Metal, Inc. Mr. Edens gave a very interesting talk on Modern Aluminum bronzes which he topped off with an excellent colored film in sound showing the production on castings. An interesting fact was made known at the meeting by Mr. Leslie MacGregor, Editorial Chairman—the projector that the Chapter uses, was made in Africa many years ago by a missionary.

Saturday, November 9, the fifth annual dance was held in the main ballroom of the Hotel Emerson. A capacity crowd turned out; in fact many had to be turned away, and there was a hot time in the old town. A floor show was given with talent taken from the Glenn L. Martin and it wasn't bad at all. All the affairs of the dance were handled very capably by Mr. E. A. Isberg, Chairman of the Entertainment Committee.

New York-New Jersey

Back in its own quarters, The Essex House in Newark, N. J., the chapter celebrated its Third anniversary with a dinner and meeting, both of which were well attended.

Chapter chairman, Wally Gray, announced that the forthcoming birthday dinner and dance at the Meadowbrook, Cedar Grove, N. J., on November 15, 1940, promises to be a great success, as 515 tickets had been sold so far.

The main speaker of the meeting was Mr. J. W. Wells, Chief Tool Designer of the Curtiss Propeller Division of Curtiss-Wright Corp., who read a very interesting paper on Tools and Gages for controllable pitch propellers. After first outlining the underlying principles of the automatic electric control mechanism, he described extensively various phases of the manufacturing process.

Mr. LaBar, of the same company, gave a demonstration with a full size model of a propeller. Both speakers had to answer numerous questions, and they did it well.

The added feature of the meeting was the showing of a motion picture by Mr. Sherwood, of American Airlines, on "Flag Ships of the Air".

After that, the members and guests enjoyed a social chat with beer and pretzels.

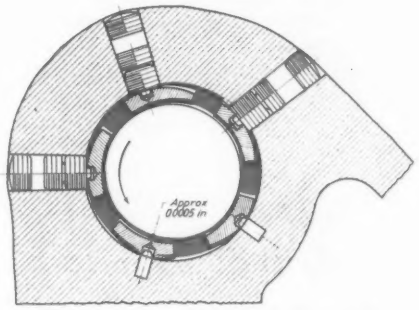
Rochester

A quotation cited by Erik Oberg about the preacher who had the telephone at his hand to save foot-steps, the numerous electrical gadgets for his home convenience, the automobile to convey him to his church, the mechanized organ for his music, the radio set-up including mechanical and technical staff at his disposal for

(Continued on following page)

ALL *Cincinnati* GRINDING MACHINES

RUN ON FILMATIC BEARINGS



The FILMATIC principle. Self-adjusting shoes produce independent, converging oil films which develop high radial pressures, forcing spindle into central position.

FILMATIC bearing construction is fully protected by U. S. and Foreign patents

AND THE SPINDLES ARE *Superfinished*

TO LESS THAN ONE MICRO-INCH

The hidden things that you can't see or feel are the ones that make CINCINNATI Grinding Machines such consistent cost reducers, month after month without interruption. For example, many painstaking operations are required to produce CINCINNATI grinding wheel spindles. Now, another operation has been added; they're superfinished on the bearing diameters to a surface quality of less than one micro-inch.

The superfinishing operation materially adds to the already amazing performance of Filmatic bearings . . . an exclusive spindle bearing construction for all CINCINNATI Grinding Machines. To mention only two advantages—load carrying capacity steps up as does life-span of the bearings. Publication G-446 gives you the whole story of Filmatic. Write for your copy today.

CINCINNATI

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI GRINDERS INCORPORATED

Manufacturers of

Tool Room and Manufacturing Milling Machines
Surface Broaching Machines Centertype Grinding Machines Cutter Sharpening Machines
Centerless Grinding Machines Centerless Lapping Machines

A. S. T. E. DOINGS

(Continued from preceding page)

broadcasting, who then goes up and broadcasts to his congregation of radio listeners about machine tools putting men out of work is just not aware of the facts. This was a high mark of the interesting talk given by Mr. Oberg before the Rochester Chapter.

Mr. Oberg was the principal speaker of the November thirteenth meeting held at the University of Rochester. His subject, "The Machine Tool Before the Court of Public Opinion" was forceful and full of good, sound horse sense. There were details which students of modern economic problems might have questioned; on the main, however, his Rochester audience agreed whole-heartedly with what he had to say.

Emphasis of our economic ills so frequently blamed upon the machine were stated as "under consumption rather than over production" as a cause. "Products of work, not work, were what the worker wanted"—Room will not permit more of Mr. Oberg's choice bits. Mr. Oberg did a swell job in proving that machine tools were a medium by which all of us have been able to realize what we today consider as necessities for conducting our daily lives. Mr. Oberg's regret that more of the preaching and teaching fraternities could not be present was shared by the Rochester crowd.

Mr. Lucas, our assistant Chairman presided in the absence of Mr. John Dense who was away on business. Past Chairman, Charlie Codd was back after several months absence caused by an automobile accident.

St. Louis

St. Louis Chapter held its regular monthly meeting Thursday, November 14, at the Melbourne Hotel. In the absence of Chairman D. D. Burnside the meeting was presided over by Vice-Chairman, C. J. Sinning. After dinner, the business session got under way and was devoted largely to completing arrangements for the Christmas Party to be held Friday evening, December 20. The Technical Session was turned over to Mr. F. D. Bowman, Advertising Mgr. of the Carborundum Company, who was on hand to properly present the sound film "Romance of Industry." The film covers broadly, grinding applications and methods as employed in industry, and also the manufacture of the abrasives. This sound film is a method for absorbing knowledge in the most pleasing manner.

Dayton

The November meeting of the Dayton Chapter was held at the Gibbons Hotel, Monday, November 11, at 8 P.M. The meeting was preceded by one of the best turkey dinners to date. Whitey Pooch is to be congratulated on serving such fine food which was enjoyed by all.

The meeting was opened by Chairman George Goodwin who reported on the semi-annual meeting held at Cincinnati. Whitey Pooch then introduced the dinner speaker, Mr. Lou Tschudi, Freshman Football Coach of the University of Dayton, who entertained by relating sidelights on his trip to the West Coast where the University of Dayton played the St. Mary's Galloping Gauls. The speaker of the evening was Mr. G. H. Sanborn of the Fellows Gear Shaper Company, who spoke on new developments in involute gearing. Mr. Sanborn illustrated his talk with slides and after the talk the boys were shown some unusual gear exhibits. Everyone who attended found Mr. Sanborn's subject interesting and instructive.

Syracuse

On Tuesday, November 10, the Syracuse Chapter held its regular meeting at the Syracuse Industrial Club. Chairman, Charles T. Allen, gave a resume of the events of the semi-annual convention held at Cincinnati in October. Mr. Russell Bull volunteered to accept the position as

(Continued on following page)

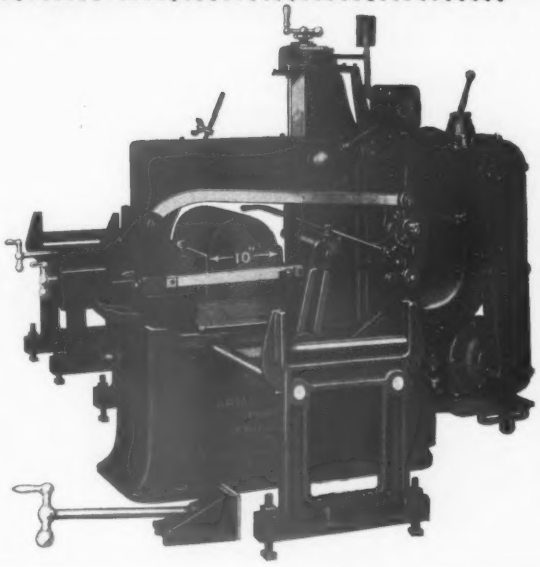
MARVEL SAWS

MARVEL SAWS cut-off metal the economical way . . . .

● The most economical method of cutting-off identical pieces from bar steel is with a MARVEL Automatic Production Saw. It will give you more pieces per hour, per machine and per dollar cost than any other cutting-off method. Figured in cost per piece, it will have the lowest tool cost and the lowest labor cost too, because MARVEL Automatic Saws operate with no more attention than an automatic screw machine. They keep chip loss down to a minimum and on many jobs will give you extra pieces per bar (extra profits).

For fast automatic production or for single-cut miscellaneous work, MARVEL 6A or 9A Hack Saws are fast, accurate tools. Capacities 6"x6" or 10"x10" single or nested bars. Write today for Bulletin No. 600.

Buy from your local distributor



ARMSTRONG-BLUM MFG. CO.

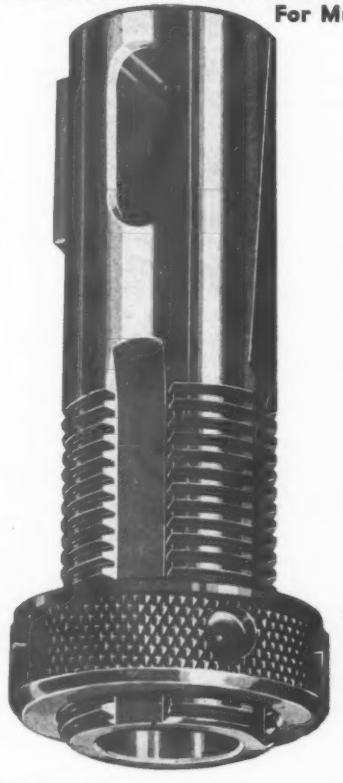
"The Hack Saw People"

5700 Bloomingdale Ave., Chicago, U.S.A.

Eastern Sales Office: 199 Lafayette St., New York

GLENZER ADJUSTABLE ADAPTERS

For Multiple Spindles



STANDARD EQUIPMENT FOR ALL DRILLING REAMING AND TAPPING MACHINES.

ADOPTED AS STANDARD BY LEADING AUTOMOTIVE AND MACHINE TOOL MANUFACTURERS

Utility Tools

THE J. C. GLENZER COMPANY

6463-6477 Epworth Blvd.

DETROIT MICHIGAN

Reclinable POWER PRESSES

This press has long been considered the most suitable and favored type for general stamping work. Its features have been standard for a number of years, but many important improvements in details make the latest model outstanding. Its high performance is the result of thorough research, sound engineering and careful designing.

The Type 36 Press is available either plain or back geared, and the models range from 4 to 100 tons capacity.

Complete information on this and other Z & H presses will be sent on request.

ZEH & HAHNEMANN CO.

192 VANDERPOOL STREET, NEWARK, N. J.

A. S. T. E. DOINGS

(Continued from preceding page)

chairman of the Educational Committee of our chapter. Mr. A. H. Mitchell, former chairman of the chapter, announced the date of the opening match of the bowling team. Mr. Joe Owens, chairman of the Entertainment Committee, informed the chapter that he was making plans for the annual dinner dance to be held the first part of the coming year.

Mr. Erik Oberg was the guest of honor at the informal dinner attended by fourteen which preceded the meeting. Forty-five members and guests attended the business session and heard Mr. Oberg speak on the topic of the evening, "The Machine Before the Court of Public Opinion." His timely topic was both interesting and informative.

Schenectady

Mr. Erik Oberg addressed the members of Chapter No. 20 at a dinner meeting held on November 11, 1940. In presenting his subject, "The Machine Before The Court of Public Opinion," Mr. Oberg discussed the effect of increased production through modern methods on public life as well as on industry. He stressed the primary objective of industry—to produce goods at a cost making them available to the maximum number of people, and at the same time, providing service expected by the consumer. It is the products of work that man desires more than work itself. If manufactured goods can be made available to the maximum number of people, we need not worry about overproduction causing depressions, which in reality, are caused by underconsumption. Mr. Oberg emphasized that the present machine age should result in a higher standard of living which will provide more leisure time to enjoy the products of work.

Under the direction of Mr. Harry Crump, Chairman of the Entertainment Committee, a very enjoyable program was presented. Chapter Chairman Fred J. Diehl, conducted a short business meeting before introducing the speaker of the evening.

Cincinnati

The Cincinnati Chapter held its November meeting at the Ohio Mechanics Institute on Tuesday Evening, November 12, 1940. In recognition of the splendid work of the past two years and fine cooperation of Mr. Lou Weber, Past Chairman and Mr. W. J. Fredricks, Present Chairman, in contributing their services for the semi-Annual Convention in October, which was so brilliant a success, the Chapter presented each with a Gavel.

After the business session, Mr. J. L. Longwell, Chief Engineer of the Carboloy Company, delivered an interesting talk on "Steel Cutting with Carboloy" and illustrated his lecture with lantern slides. Among the points stressed by Mr. Longwell were: application of coolant is very important; individual pipes for each tool applying the coolant under pressure at the point of contact with tool and work should be used; where heavy chips are involved; proper application prolongs life of tool, cools chips so they break up more readily; proper grinding of tools was recommended for free cutting; a mechanical chip breaker or one ground in the tool should be used.

York

York Chapter No. 22 had a very interesting meeting in November at the West York Inn. The dinner talk by Mr. Paul Gardner, President of DeWalt Products, proved very interesting. He talked about unusual happenings in his world travel. The technical speakers were Mr. C. L. Boughter and Mr. Harold Sneed of DeWalt Products whose subject was "Production and Design" illustrated by sound movies. We cannot give enough praise for this meeting as it was the type of meeting that is making our chapter a success. The chair had to "bang" the

gavel at 11:30 or the boys would have stayed all night.

Tri-Cities

Tri-Cities Chapter, A.S.T.E. held its regular monthly meeting on November 6th at the LeClaire Hotel, Moline.

The speaker for this occasion was Mr. Francis D. Bowman, Advertising Manager for the Carborundum Company and author, producer, and announcer of Carborundum's coast-to-coast radio program. The subject of his address was "The Manufacture of Abrasives and Abrasive Products." Mr. Bowman gave the early history of abrasives and their increasing uses on up to the present day. He stated that the field of abrasives is so large that today's modern abrasives range from small abrasive wheels used by the dental profession up to abrasive equipment for cutting and polishing marble in the building industry. Following his talk, Mr. Bowman showed the Chapter a sound motion picture on the manufacture of modern abrasive products and many of their industrial and commercial uses.

The following men were welcomed into membership in the Chapter at this meeting: Wm. L. Bauwens, Rock Island Arsenal; John Edwards, Reynolds Engr. Company, Robert Henry, Reynolds Engr., Company; and L. J. McWilliams, Reynolds Engr. Co.

Elmira

The November meeting of the Elmira Chapter No. 24 of the American Society of Tool Engineers was held in the Langwell Hotel on November 14. The twenty-eight members present were enthusiastic over the talk given by Mr. Erik Oberg on "The Machine before the Court of Public Opinion."

Following Mr. Oberg's talk, a discussion on "Plug Gage Construction and Use" furnished the remainder of the program.

The Chapter is sponsoring a class in "Instructions in Speaking." All members who are interested may join the class.

Worcester

The October meeting of Worcester Chapter, No. 25, A.S.T.E. was held at Putnam & Thurston's on Monday, October 14, 1940.

The business session was preceded by a dinner meeting at 6:30, and during the dinner a musical program was enjoyed in which the speaker of the evening, Mr. Martikee took part at the piano.

The business session opened at 8 P.M. at which time Chairman Ray Cole gave a notice of the special meeting to be sponsored by Worcester Chapter on October 21 at Norton Co. This meeting is a new activity of Worcester Chapter and if the response of the membership warrants it will become a monthly feature. He also gave notice of the November meeting to be held Tuesday, November 12 in Athol. Arthur Starrett and George Gover are in charge of that meeting and an interesting program is to be expected.

Mr. Martikee of the New England Coke Co. then showed a film entitled "The Iron Men of New England". This picture showed the mining and transportation of iron ore, the manufacture into iron and the final molding of the iron at various New England foundries. This picture was prepared by the Mystic Iron Works and New England Coke Company. The Mystic Iron Works is the only smelting works in New England. It was in technicolor and sound and was an extremely interesting and educational feature. After this picture two short reels were run, one entitled "Fishing" and the other "Football".

The meeting adjourned at 9:30 after giving Mr. Martikee a rising vote of thanks for the fine pictures shown.

Golden Gate

The regular monthly meeting was held on Tuesday, Oct. 10, at the Engineers Club, 206 Sansome Street, San Francisco. Dinner was served at 6:30 p.m. attended by approximately 72 members and guests.

Before the technical sessions started. Mr. Kassebohm explained to the mem-

(Continued on following page)

A. S. T. E. DOINGS

(Continued from preceding page)

bers that the Executive Committee recommended that the Tool Engineers stage a burlesque show enacted entirely by members. The idea was to invite guests to this show and charge fifty cents for tickets, thereby boosting the Chapter Treasury. The discussion which followed brought out that not enough members would be willing to participate in such a show and so it was recommended to have a stag party instead.

The business meeting started at 8 p.m. Mr. C. J. Oxford, Chief Engr. of the National Twist Drill and Tool Company, spoke on "Metal Cutting Problems and Their Solution in the Shop."

Mr. Oxford gave an analysis of typical metal cutting jobs with recommendations for economical tooling and machine set up. He explained the correct cutting angles for different metals on twist drills and milling cutters. His talk was also illustrated with slides. A very interesting and lively discussion followed.

South Bend

The South Bend Chapter held their First Anniversary Meeting on November 14th in the Rotary Room of the Oliver Hotel. The coffee speaker of the evening was Mr. Tousley of the United States Secret Service, who spoke on "Know Your Money."

Mr. Parker B. Smith, of the Socony-Vacuum Oil Co., led the technical session with a talk on "The Inside Story," which dealt with the application of oil lubrication in industry. His talk was accompanied by films.

Springfield

The monthly meeting of the Springfield Chapter was held Monday evening, October 28, 1940 at the Hotel Bridgeway. Over forty attended the dinner and enjoyed a film in sound and color of a Milwaukee Rotary Head Die Sinking Machine.

Mr. Curtis called the meeting to order at 8:05 o'clock and announced seven new members taken in prior to the opening of the meeting. About one hundred sixty attended this session.

The secretary's report was read and accepted.

Attention was called to the books "Verbatim Report of Technical Sessions", A.S.T.E. Annual Meeting March 7th—8th 1940 held at New York City. Several books were passed out for inspection.

At this point the meeting was turned over to Mr. Harold Craig, Chairman of the program Committee, who introduced Mr. G. H. Sanborn, Engineer Fellows Gear Shaper Co. who illustrated with Slides his talk on "New Developments in Involute Gearing."

After a question period the meeting was adjourned at 10:30 o'clock.

Boston

Boston's November meeting was held on the 14th with dinner at the Smith House in Cambridge. Through the kindness of Mr. P. P. Sturgis of the Taylor Wine Company, Hammondsport, New York, and Mr. J. G. White, Massachusetts Agent of the same company, our members and guests had ample opportunity to sample the delicious wines made by the Taylor Wine Co. Directly after the dinner, Mr. Sturgis and Mr. White showed us a most interesting moving picture of the making of wines from the growing of the grapes to the bottling of the product.

At the Technical Session, Mr. J. W. Geddes, Chairman of the Round Table Discussion Groups, made a report on the Discussion Group on "Methods." Mr. Geddes talk resulted in the forming of new groups on "Production Control" and "Cutting Tools." These groups are limited in size to eight or ten men, in order that each member of the group will have ample opportunity to bring up his problems.

Mr. Charles I. Kraus, Industrial Sales Manager of the Alemite Division, Stewart Warner Corporation, presented an inter-

A. S. T. E. DOINGS

(Continued from preceding page)

esting talk on the subject of Lubrication. He showed by charts, slides and actual demonstrations how various lubricating devices work. He also explained industrial greases and told why they were necessary to the proper lubrication of machine parts.

Greater New York

Greater New York Chapter held its October Meeting in the Main Ballroom of the Clinton Hotel on October 14.

Mr. Joe Brady, Chairman of the Membership Committee, reported that the Chapter had now 170 members, whose applications had either been approved or waiting action by the National Membership Committee.

Mr. Blye, Chairman of the meetings committee, then introduced the speaker of the evening, Mr. H. A. Moore, General Sales Mgr. of the Foster Machine Co., Elkhart, Indiana. Mr. Moore gave an interesting and provocative discussion illustrated by motion pictures and slides of various machines now being used in developing "Superfinished" surfaces. This was followed by an exceptionally active question and answer period in which a large number of members participated.

The discussion following this talk was one of the most animated and instructive of any yet had before this Chapter.

Western Michigan

The first meeting of Chapter No. 38 was held Tuesday, November 12, in the Browning Hotel in Grand Rapids. Mr. J. Monahan, the Chapter chairman, acted as toastmaster. The main speaker of the evening was Lt. Gordon Gary of the U.S. Army, whose subject was "Industry on the Firing Line". Following Mr. Gary, we heard from Mr. Butterfield on what he saw on the plant tours at the Convention. Mr. J. Mullen spoke on the technical subjects at the Convention; Mr. Brierly on the various lectures he attended; Mr. R. Parkes on the various lines of the Cincinnati Tool Company, and Mr. J. Monahan on the progress of the National Organization of Tool Engineers.

The meeting was closed after a round-table discussion.

Bound in this issue is a post card which you will find convenient in ordering booklets listed in "New Literature", or more information on items in "It's New".

Handy Andy Says—

THIS is written in the drab hangover following the election, from which you may infer that my candidate "also ran". But how! Well, the verdict has been rendered and we'll just have to settle down to four years more of the same, although one may assume that, due to a close popular election (proof that the New Deal didn't have unanimous approval) the ship of state will probably take a tack to starboard. At that, I give the Old Campaigner credit; like the ball player who goes after the hard ones, he has made his errors. But then, there is no sense in repeating mistakes. Take the Tool Engineers, for example. We have to evolve new ways to meet the increasing demands for mass production, and inevitably there will be bugs even in the best designs. But these are ironed out, and finally the "machine" runs smoothly and efficiently. So with the machinery of government, and a wise Chief Engineer will discard the unworkable and remold the concept "near to the heart's desire". What say, Chief?

▼ ▼ ▼

Funny, isn't it, how the machine came into its own all of a sudden, although there are die-hards who would turn the clock back. Like an old fellow I know. "They put in a machine, and right away a dozen men are laid off". Then, grudgingly, after I had tried to show him the error of his ways: "Well, maybe they cut costs so more people can buy automobiles and such, but by gum you can't get manure out of the exhaust of a tractor". Which started another argument, but never mind that now. The point is that the educational campaign on behalf of the machine isn't done with by a long shot, and I'm beginning to think that the men most sadly in need of enlightenment are the boys on the production lines who man the tools we design.

▼ ▼ ▼

During the past year, we have had direct evidence that tools and machinery designed to lighten the burdens of labor and, incidentally, to cut production costs, have failed to function to anywhere near capacity because of deliberate slowdowns. Line stewards arbitrarily establish rates of production which in many cases are unreasonably inadequate, and that is what you are going to get even if the men have to work the harder "acting busy". Which is analogous to the Greek in the fable, whom I may have mentioned before. As fast as he braided, a jackass standing behind him ate the rope. Of course, the boys aren't as smart as they think; they're just kidding themselves. Because, the lower production rate boosts the cost of product, which the public eventually pays for. Inversely, reduced costs (say in an automobile) would also be passed on to the buyers, which include the workers who build them. Hence, slowdown isn't even smart policy in the manufacture of peacetime commodities, can be a serious handicap in the execution of our Defense Program. That's one for Uncle Sam to mull on.

▼ ▼ ▼

Reading various trade journals, most of which are now attuned to the martial tempo, I note how a phrase, coined some time ago, in one of the Tool Engineer editorials, is beginning to take. "Tool Engineers, the key men of Industry." Well, we've been a long time getting recognition, but it looks as if we have arrived. For that, thanks to the A.S.T.E. Right now, Tool Engineers are very much in demand, with the shortage becoming acute as youngsters barely out of school crash the above average salary brackets. One concern that I know of hires about everyone that steps off the elevator unless he be a customer—uh, client, I mean. Excuse the slip; we must

(Continued on following page)

HANDY ANDY SAYS

(Continued from preceding page)

be professional, you know. Oh well, I recall a previous international debate when the ginnies across the tracks were sporting silk shirts at $15 per, the while the Tool Engineers (variously titled then) laundered their celluloid neckwear under the kitchen tap. Now, the T. E.'s are going to have their inning, and I am for them; "the laborer is worthy of his hire". But, before you boys jump the fence into greener fields I'd suggest that you talk it over with the Old Man. Then, if you are still worth enough more to a competitor to change, why you've got a clear conscience. Thank gosh, we're not enthralled by seniority, but then, we have our code of principles. It works both ways.

▼ ▼ ▼

The Lunch Hour Foursome got to reminiscing about the last war one noon, the discussion being none too complimentary regarding government inspectors as they functioned in '18 and thereabouts. To recount all the inspection boners pulled in that hectic day would fill a library, and I have no yen to compile them. But I recall rejections because a boss on a casting or forging, having no other function than to surround a hole and bush the air, wasn't within the tolerances implied by a decimal dimension. Oh sure, it wasn't altogether the fault of the inspectors; shavetails as civilian fledglings, they read the letter and were blind to the spirit. The fault, often as not, lay with the product engineers—who still give the Tool Engineers plenty of headache at times. Personally, I think the present program will be greatly expedited, with more of harmony and mutual respect, if practical men be given the job of supervising product design before the component parts are tooled for mass production. While we want to improve on the machinery of defense (we won't say war until we have to) as we go along, we do not want to lose sight of standardization and interchangeability. What we do, let us do thoroughly; even our critics will bless us for that, should the gauntlet be thrown. Time levels all things.

▼ ▼ ▼

Humanity blunders its way to a goal, and to my way of thinking, the most colossal blunder of all time is the present senseless war. No, I'm not a pacifist; I just want things projected on sense. It is not sensible, in an age when the world has suddenly shrunk because of modern communication and transportation, that men should kill each other and slaughter women and children when negotiation and compromise would settle differences. In my opinion, we were negligent when, Wilson having formulated a League of Nations, we did not support it, but left its destiny to small nations and temporarily bankrupt but ambitious powers. Yet, before we can truly achieve civilization, there must be effected a concord of nations, call it by what name you will. Better a bridge that joins nations than battlefleets that destroy them. But, until the world learns, the Guardians of Freedom must prepare. With the election over, let us be solidly united in our Defense Program. (No slowdowns).

▼ ▼ ▼

I read, with unfeigned sadness, of the passing of Neville Chamberlain. Reviled by his critics, (and I threw a few barbs myself) historians will doubtless deal more kindly with the late Prime Minister than his contemporaries. For Chamberlain had rare courage; he dared to champion the cause of peace, and failing that, he sacrificed himself that England might

(Continued on following page)

PRECISION DISC GRINDING

Some Practical Applications

In the January Tool Engineer

HANDY ANDY SAYS

(Continued from preceding page)

have time to prepare for war. True, there may be cause for criticism; war seemingly inevitable even during the negotiations at Munich, why didn't the British get going?—why weren't they prepared right along?—why, instead of heeding Lindberg's warning, did they heap calumny on a man who told them the truth? I can't answer those questions, nor can any of us; the beam before our own eyes obscures the mote in our neighbor's. For we are making a belated start, too. But, to the everlasting credit of the British be it said that, when Poland was attacked, and Norway, and Holland and Belgium and France, the British were there, trying. And they are still trying, in Greece, Asia, Africa, at home! Practically alone, they keep on fighting, and a nation so tenacious should not fall. They had the courage to champion peace, and they've got the guts to fight a war to the bitter end. They are real people, and they speak our language. May the time come when we'll all speak a common language—that of mutual understanding. I believe that Neville Chamberlain had a vison of that Utopia.

Yours Sincerely,
Handy Andy.

TRIPLETS

At Packard, Tool Engineres are busy increasing production of marine engines from one a day to three a day. This speed-up for National Defense will be completed in January, and in January The Tool Engineer will carry the full account of how this production was tripled.

THE Passing Parade

Jack Marvin, Treasurer of the Southern California Chapter, has severed his connection with the Machinery Sales Co. at Los Angeles and is joining the Shaw-Palmer-Bakewell Co., Inc.

Richard E. Long has been named general manager of the recently reorganized Eagle Rubber Co., Inc., Ashland, Ohio. Long, a native of Ashland, has been with Sieberling Latex Co. in Barberton, Ohio, 12 years.

A. Oakleigh Bush has been appointed assistant chief sales engineer of the abrasive division of Norton Company, Worcester. Mr. Bush has been with Norton Company for about 16 years, first in the electric furnace plant at Niagara Falls and then in the research and sales engineering departments at Worcester. In 1937 he was transferred to the Norton London office and later to the English plant at Welwyn, becoming its acting general manager in 1939. He returned to Worcester about a month ago with other American members of Norton Company's European staff.

Employees of the Production Tool and Die Co., Springfield, Mass., surprised Mr. and Mrs. Richard J. Gaudreau, Nov. 3 on the occasion of the couple's 25th wedding anniversary and presented them a pair of candlesticks. Mr. Gaudreau is president and treasurer of the concern. which he founded in 1931. He is a member of the American Society of Tool Engineers.

Ralph E. Flanders, president of Jones and Lamson Machine Co. and president of the Bryant Chucking Grinder Co., both of Springfield, Vt. was elected president of the New England Council at the 61st quarterly meeting of the council directors Nov. 14 at Boston. He is a member of William S. Knudsen's Machine Tool Coordinating Committee. He is also past president of the National Machine Tool Builders, inventor of more than 20 machines and mechanical improvements, and member of the National Screw Thread Commission.

Frederick V. Geier, president, Cincinnati Milling Machine Co., was selected president of the National Machine Tool Builders Association at their annual meeting in Chicago. Clifford S. Stilwell, vice president, Warner & Swasey Co., was named first vice president. L. W. Scott Alter, Cincinnati, was one of three new directors chosen.

(Continued on following page)

PASSING PARADE

(Continued from preceding page)

Died

Edward Francis Smith, 52, District Manager of Haynes Stellite Company, Chicago, Illinois, died September 26 at Rochester, Minnesota. Mr. Smith was born at Hannibal, Missouri, and learned the practical aspects of the machinist's trade in his father's shop there. He became a sales engineer with Haynes Stellite Company in 1920 and a few years later was appointed District Manager in the Chicago area, which position he held at the time of his death. He was well-known as an author and speaker on metallurgical and metal-machining subjects and was prominent in the activities of the American Society of Tool Engineers.

Charles L. Allen, 82, chairman of the board of Norton Co. and until his retirement in 1933, for 48 years its general manager. He started with the Norton Co. in 1881 as a bookkeeper. He rose with it as the company developed from a struggling pottery shop employing thirteen men to its present position in the grinding field and a roster of 6000 workers. During his lifetime he found time to take part in innumerable activities and to further the work of many philanthropic agencies in which he was interested.

Three officials of the Wickwire Spencer Steel & Wire Co., were drowned on a hunting trip in the wild, isolated Allagash country of Maine, north of Moosehead Lake. They perished in frigid waters when a canoe capsized in a sleet storm. They were: Paul M. Macklin, 54, of Tuckahoe, N. Y., vice president and general manager of the company and former superintendent of the Goddard Works at Worcester, Mass.; John Macklin, 25, of Buffalo, N. Y., his son, a foreman at the Buffalo Works; George W. Nelson, 48, of Buffalo, superintendent of the Buffalo Works, and until 18 month ago superintendent of the Goddard Works. He was also superintendent of the Clinton, Mass. plant 1928 to 1930.

Thomas F. Howarth, 77, vice president of the Simonds Saw & Steel Co., and prominent in social and industrial life died Nov. 2 after a long illness. He had been associated with the Simonds company for 60 years and had served as vice president for more than 25 years. Prior to that time he was an auditor with the same concern.

December Meetings

BINGHAMTON—Dec. 12. Sherbood Hotel, Green, N. Y. Round table discussion of Tool Engineering problems.

(Continued on following page)

Man's a Funny Crittur

by Earl V. Johnson

Man's a funny crittur
Be he worker or a quitter,
For he's aluz wantin' more'n he can earn.
Just a weak and puny porter
Earnin' dimes—he wants a quarter
En a lowly simple jitney he would spurn.

En the painter or the mason
In their work they do not hasten
Since they got a raise in pay for all their work.
No, by gum, they want less hours
En the gov'ment kowtowers
En starts lookin' for sumthin' that's berserk.

I don't care what you are doin'
Bakin', printin', bankin', brewin',
Sumthin NEVER comes from nuthin', is tha rule
That's cum down from out tha ages
Thru all the economic stages
En ya learn that in an element'ry school.

Now the banker tried ta do it
'Till tha people all saw thru it
An' tha doggone pyramids toppled witha crash;
When tha smoke had cleared away
Thar was no more wealth that day
Than thar was when Eve an' Adam wore a sash.

Give tha clerk a cool two hundred
Ev'ry week, tho he has blunder'd
Give tha office boy fi' thousan cash a year,
Why they'll never cease their yellin'
En'll keep forever tellin'
That the steno makes tha boss giv mor they fear.

Thar's tha guy on tha machine
Makin' dollars umpty steen
En his wife is makin' lotsa dough besides,
But he'll ask fer a retainer
Pritty soon to just sustain 'er
So he kin stop her criticizn' and her chides.

They fergit that all tha wealth
Even whut we count fur health
Cums from Mother Earth, tha air, an frum tha seas.
En tha energy, by gum
That transforms it tu en frum
Is agift frum these same sources, if you please.

That sum-one thru sweat en work
Mixed with brains that didn't shirk
Hev transformed it intu sumthin' that was wanted.
They say works all right fer Joe
Or sum heathen or hobo
En they treat a job like it wuz sumthin haunted.

Wages may be readjusted
Till tha hull dern world is busted
They'll be kickin' long as thar's a single fool.
Dough may not be wurth a fig
But thar's wealth if ya will dig
Fur sumthin NEVER cums frum nuthin' is the rule.

Correction: The article "Cooperative Education", appearing in last month's issue, was by Dr. R. C. Gowdy, Dean, College of Engineering and Commerce, University of Cincinnati.

December Chapter Meetings

(Continued from preceding page)

BALTIMORE — Dec. 4 Dinner 7:00 Technical Session 8:30 Sears Auditorium, North and Harford Ave. Mr. F. D. Bowman, Adv. Mgr., Carborundum Co., will speak on "Manufacture and Uses of Modern Abrasives."

BOSTON—Dec. 12. Dinner, 6:15, Smith House, Memorial Drive, Cambridge. Technical Session, 8:00, Room 6-120 Eastman Bldg. M.I.T. Mr. Ralph E. Flanders, President of Jones and Lamson, will speak on "Tool Engineering."

CENTRAL PENNSYLVANIA—Dec. 10. Dinner, 6:30. Technical Session, 8:00. West York Inn, Market & Highland, York, Pa. Mr. Francis J. Trecker will speak on "Modern Methods of Tool and Die Milling." Reservations: H. E. Hibner, York Corrugating Co.

CHICAGO—Dec. 2. Smoker at Midwest Athletic Club, Hamlin and Madison Sts. Exhibits open at 7:00. Sound and color film "Steel—Man's Servant" at 8:00. Open discussion and entertainment. Beer, coffee, and sandwiches from 9:00. Reservations: Mr. Croft, Van Buren 8200. Open to friends and prospective members.

COLUMBUS—Dec. 6 Holiday meeting. Parkview Hotel Ballroom, 500 W. Goodale Street. "Foam, Food, Fun." Bring a prospective member or a friend.

DAYTON—Dec. 9. Dinner 6:30, Gibbons Hotel. Mr. J. D. O'Brien, Prod. Mgr., Inland Mfg. Div., General Motors will speak. Reservations with "Whitey" Pooch.

ELMIRA—Dec. 12. Langwell Hotel. F. H. Palmer, Assistant to the Pres. Carpenter Steel Company, will show slides and speak on the manufacture of tool steel.

HARTFORD—Dec. 2. Dinner, 6:30, City Club. Technical Session, 8:00, Hartford Gas Company Auditorium, Pearl St. Lt. Col. P. W. Bidwell will speak on National Defense.

NEW YORK-NEW JERSEY — Dec. 10. 8:00 P. M., Robert Treat Hotel, Park Place, Newark, N. J. Motion picture: "The Long Road", courtesy Ethyl Gasoline Corp. Speaker: Mr. John Haydock, Managing Editor, American Machinist.

MILWAUKEE—Dec. 12. Dinner, 6:30. Technical Session, 7:30. Boys Trade and Technical High School. Welcome by T. G. Brown, Day Principal. "How the Industrial Arts Assist in the Defense Program" by Roy Radtke. "How Trade Education Assists in the Defense Program," by Fred W. Ziegenhagen. Open House.

ONTARIO — Dec. 13. Dinner, 6:30, Oak Room, Union Station, Toronto. Mr. Ed. Barker will speak on "Plastic Moulding Dies."

PITTSBURGH—Dec. 6. Dinner, 6:30, Technical Session, 8:30. Stouffer's Restaurant, Wood and Diamond Streets, E. V. Crane, of the E. W. Bliss Company, will speak on "Plastic Working of Metals by Power Pressing."

PHILADELPHIA — Dec. 19. Dinner, 6:30. Engineers Club. Joseph Gray Jackson will speak on "Odd Patents." Mr. E. W. P. Smith, Consulting Eng., Lincoln Electric Co., will speak on "Fabrication as applied to Tools, Dies, Jigs, and Fixtures."

ROCHESTER—Dec. 11. Technical Session, 7:45. Lower Strong Auditorium, University of Rochester. Frank R. Palmer, of the Carpenter Steel Co., will speak. Reservation: C. G. Newton, Stone 2893.

ROCKFORD—Dec. 5. Dinner 6:00, Hotel Faust. Ralph E. Flanders will speak on "Modern Development of Thread Grinding." Dinner $1.00 Reservations: Allis Chalmers, Main 6270.

SCHENECTADY — Dec. 9. Technical Session, 8:00. Rice Hall, General Electric Co. Frank Palmer will speak on "Tool Steel."

SOUTH BEND—Dec. 12. Dinner 7:00, Technical Session 8:00. Oliver Hotel. Mr. G. E. Brumbach of the Carpenter Steel Company will speak on "Tool Steel Applications."

ST. LOUIS—Dec. 20. Christmas Party at 7:00 for members and wives. Melbourne Hotel, Grand & Lindell Blvds.

SYRACUSE — Dec. 10. Dinner, 6:30, Technical Session, 8:00. Syracuse Industrial Club, 226 W. Genesee St. F. H. Palmer, Assistant to the President, Carpenter Steel Co., will speak on "Tool Steel."

TOLEDO—Dec. 10. Dinner 6:30, Toledo Yacht Club. Reservations: R. H. Mogle, 3722 Leybourne Ave., La 8783. Program: Surprise!

TRI-CITIES—Dec. 4. Dinner, 6:30. LeClaire Hotel, Moline. Ernest Flanders, Jones & Lamson, will speak on "Thread Grinding." "Professor" Oakes with his goofy inventions will be an added feature. Second annual dinner meeting—ladies invited.

ADVERTISERS' INDEX

The Tool Engineer

***Advertising Offices:* New York, Chicago, Providence, Detroit San Francisco, Los Angeles**

(See page 3 for addresses)

Please mention "The Tool Engineer" to advertisers when making inquiries

INDUSTRIAL RELATIONS COMMITTEE A. S. T. E.
2567 W. Grand Blvd., Detroit, Michigan

PERSONAL SERVICE FOR MEMBERS

SITUATIONS AVAILABLE

MECHANICAL ENGINEER—Under 40 years of age, American born, must have machine layout, conveyor layout and industrial ventilation experience. Location—Detroit, Michigan.

MECHANICAL DRAFTSMAN—MAXIMUM AGE 45 years, American born with piping drawings, conveyor layout and general mechanical drawing experience. Location—Detroit, Michigan.

MOTION AND TIME STUDY ENGINEER—To make time and motion analyses by use of watch or film, Compile Standard Data, Establish base rates, piece rates, and fatigue factors. Aid in the installation of incentive systems. Location—Northwestern Pennsylvania.

TOOL ESTIMATOR*—To layout the sequence of manufacturing operations for tool room work based on finished drawings covering small size, intricate, close tolerance tools or dies. Calculate and establish standard hours for such tool room manufacturing operations. Location—Northwestern Pennsylvania.

SITUATIONS WANTED

EXPERIENCED LAYOUT DRAFTSMAN—Has had experience in Chassis Layout and detail—Mechanical Drafting—and Fixture Layout and detail work. Available for employment in Detroit or the immediate nearby vicinity.

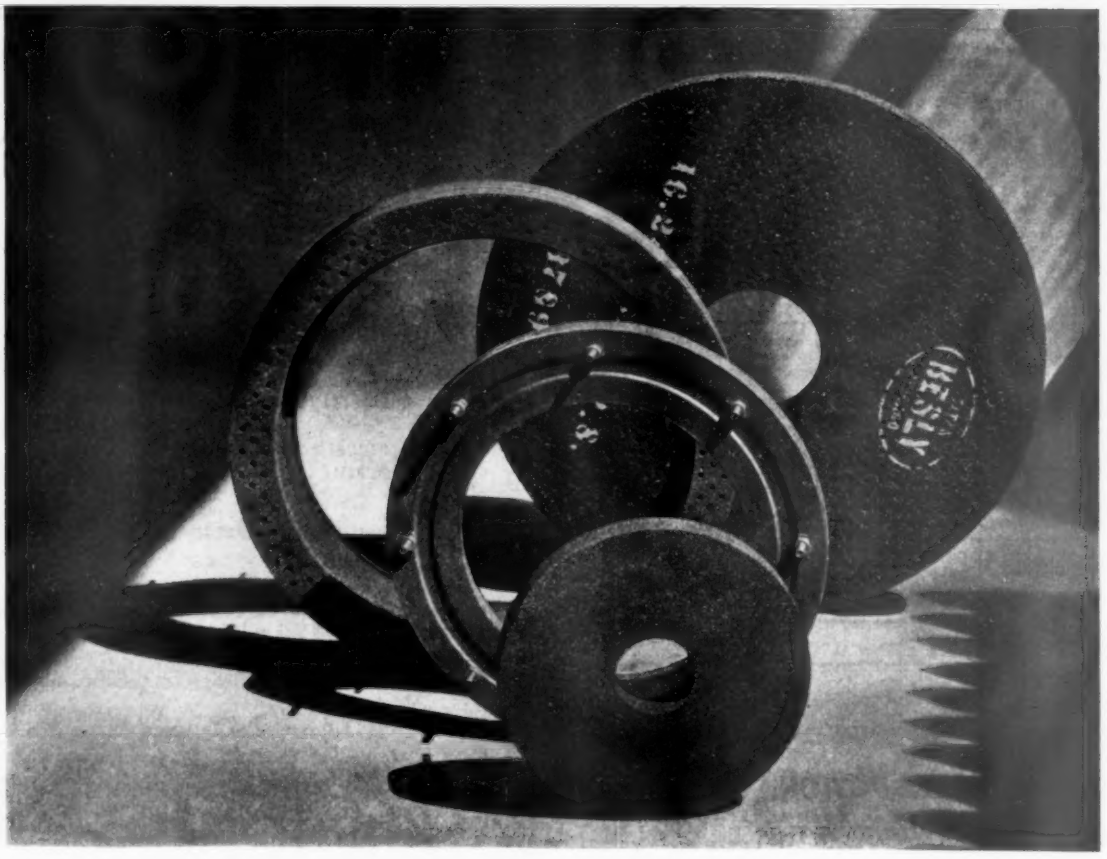
LAYOUT AND METHODS ENGINEER—With a wide experience covering Cost Reduction, Inspection and Testing, Tool Designing, Tool Developing, Operation Layout, and Cost Estimating. Available for employment. Prefers to locate in New England States. Will accept position in Detroit or Chicago area if conditions are satisfactory.

CLASSIFIED ADVERTISING

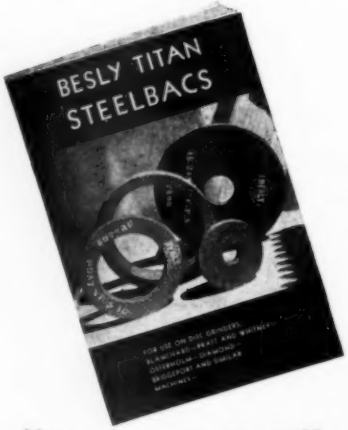
The Tool Engineer, 2842 W. Grand Blvd., Detroit, Michigan

WANTED BY PROMINENT MACHINE TOOL MANUFACTURER located in the middle west, man capable of making time studies and production estimates on chucking, bar and fixture work. Good compensation and permanent position to right applicant. Address Box 712, Tool Engineer.

BESLY TITAN STEELBAC ABRASIVE DISCS



The Besly Titan Steelbac Abrasive Disc—the first practical Resinoid Bonded Bolted-On Abrasive Member originally introduced by us early in 1928. Since that time this product has been constantly improved and its scope broadened. That it is an outstanding contribution to the art of grinding is attested by its universal acceptance. • If you operate a Blanchard, Pratt & Whitney, Diamond, Osterholm, Bridgeport or similar machine, investigate the possibilities of Besly Titan Steelbac Abrasive Wheels. • Buy grinding members for Disc Grinders from the leader.



Write for your copy of Booklet on Besly Titan Steelbacs.

CHARLES H. BESLY AND COMPANY

118-124 NORTH CLINTON STREET ★ CHICAGO, ILL.

EFFICIENT HOLDING OF WORK

for many different operations

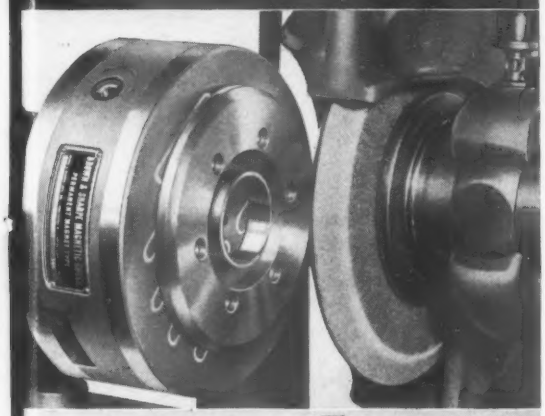
With BROWN & SHARPE MAGNETIC CHUCKS

Permanent Magnet Type

No Wires —
No Heating —
No Running Costs —

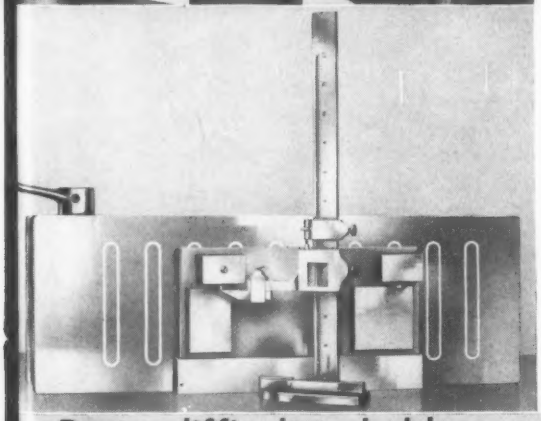
Wet Grinding

Light Lathe Work

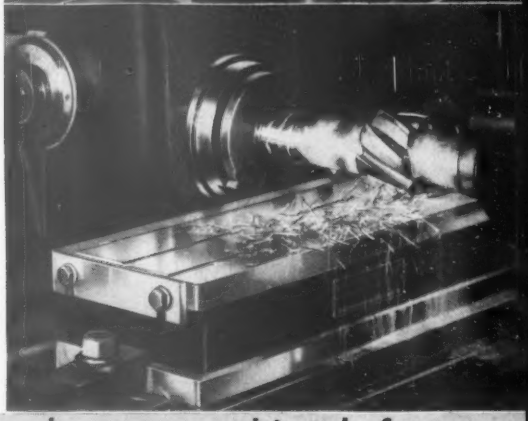


Dry Grinding

On Shapers



Layout or Bench use



Light Milling Cuts

Parts difficult-to-hold as well as ordinary work are machined faster and more easily when held on these Permanent Magnet Type Chucks. Write for circular describing Rectangular and Rotary Models.

B·S Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

For sale only in the U. S. A. and its Territories

BROWN & SHARPE

When SPEED is ESSENTIAL

There's often a real need for speed. Lack of it sometimes proves disastrous. Take the present all-too-obvious need for speedy productive capacity in industry. Speed is now of vital importance. It can best be served by modern machine tools.

LeBlond is ready to step up the productive capacity of the nation . . . ready to set the pace, with its lathes and cutter grinders . . . modern machine tools that will not only produce more units per hour, but more *perfect* units, with fewer scrap losses to eat into profits.

THE R. K. LEBLOND MACHINE TOOL CO.
CINCINNATI, OHIO